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PROGRESS REPORT ON RESEARCH AND RELATED SERVICE
APPLICABLE TO
→ DAIRY

Including Work in United States Department of Agriculture
and Certain State Work Financed in Part with
Agricultural Marketing Act Funds

Prepared for Use in Connection with the
December 1955 Meeting of the
Dairy Research and Marketing Advisory Committee

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This progress report is a "tool" for: (1) administrative use in program development, coordination and evaluation; (2) advisory committee use in formulation of recommendations in regard to present and future programs. The material in the report is not for publication. Included are many tentative or indicated findings that have not been sufficiently tested for public release. As soon as these results are ready for release, the information will be released promptly through established channels. The report also includes research findings that have already been released. The publications containing the public release are cited. Public reference to the findings that have been released should mention the publication in which the release was made, NOT this progress report.

For the reasons given, copies of this report are available only to research administrators and workers directly concerned with the development and conduct of the program and to advisory committee members. Those receiving it are asked to observe strictly the limitation: "Administratively Confidential -- Not to be quoted or copied."

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UNITED STATES DEPARTMENT OF AGRICULTURE
Washington, D. C.
October 1955

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FUNCTIONS OF ADVISORY COMMITTEES

The Dairy Research and Marketing Advisory Committee is one of a number of committees authorized by Congress in 1946 to advise the Department of Agriculture with respect to specific research and service programs.

The committees have been asked to consider all of the research and marketing service work of the Department in their respective fields. This is in recognition of the value the Department places upon the advice and counsel received and is in accord with suggestions of Congressional committee members who are directly concerned with the work.

These committees are performing an important function in advising with respect to the development of the Department's research and marketing service programs. However, it is recognized by members of Congress, committee members, and the Department that the implementing and administering of these programs are the responsibility of the Department.

The functions of the advisory committee men include:

1. Acquainting themselves with the problems of producers, all segments of the industry and of other groups, and presenting them for committee consideration.
2. Reviewing and evaluating the current research and marketing service programs of the Department, including work under way at Federal laboratories and field stations.
3. Recommending adjustments in the Department's program, including priorities for new work and expansion of work under way.
4. Developing a better understanding of the nature and value of the agricultural research program, explaining it to interested persons, groups and organizations and encouraging the wider and more rapid application of the findings of research.

COOPERATION

Much of the dairy research covered in this report is conducted in cooperation between agencies of the United States Department of Agriculture and the State Experiment Stations. The studies find their origin in problems of producers, processors, distributors and consumers, and representatives of these groups frequently participate in the cooperation. Cooperative programs are jointly planned and conducted in a manner to make full use of the personnel and resources of each participating group with the minimum of duplicative effort. The results of cooperative research are jointly prepared in the form of uniform recommendations.

SYMBOLS USED TO DESIGNATE REPORTING AGENCIES

ARS - Agricultural Research Service

AE - Agricultural Engineering Research Branch
ADP - Animal Disease and Parasite Research Branch
APH - Animal and Poultry Husbandry Research Branch
DH - Dairy Husbandry Research Branch
ENT - Entomology Research Branch
EU - Eastern Utilization Research Branch
FC - Field Crops Research Branch
HHE - Household Economics Research Branch
HN - Human Nutrition Research Branch
PE - Production Economics Research Branch
SWC - Soils and Water Conservation Research Branch

AMS - Agricultural Marketing Service

AEc - Agricultural Economics Division
AEs - Agricultural Estimates Division
MRD - Market Research Division
 BS - Biological Sciences Branch
 MD - Market Development Branch
 OC - Market Organization and Costs Branch
 TF - Transportation and Facilities Branch
SDA - Liaison Matching Funds Program, State Departments of Agriculture

FAS - Foreign Agricultural Service

FCS - Farmer Cooperative Service

FES - Federal Extension Service

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PROGRESS REPORT
for
DAIRY RESEARCH AND MARKETING
ADVISORY COMMITTEE
December 10-13, 1956

I. PRODUCTION

A. NUTRITION AND FEEDING

1. Rumen Bacteriology of Growing Calves

ARS-DH

The development of the microbial population in young dairy calves as affected by systems of rearing and following rumen inoculation has been determined. Calves reared under normal feeding and calf barn conditions but without direct contact with mature animals develop a rumen bacterial population typical of mature animals in 6-9 weeks after birth. Rumen inoculation did not hasten this development under these conditions of rearing. Calves raised in other quarters under strict isolation, developed a bacterial population which was not typical of mature animals but characterized by high anaerobic counts. The typical mature population developed rapidly in these calves after rumen inoculation. There appeared to be no advantage in weight gains, general appearance, or in total digestible nutrients consumed per pound of gain in the inoculated calves as compared to those in the strictly isolated group. The isolated calves with the most abnormal flora made good weight gains and consumed large amounts of roughage.

Plans

Detailed examination of the types of bacteria found in this experiment will be made and their significance in rumen fermentation determined.

Publications

The Development of Rumen Micro-Organisms in Inoculated vs Isolated Calves.
M. P. Bryant and Nola Small. ARS Information Series 52-31, 1956.

2. Characteristics of Rumen Bacteria

ARS-DH

In continuation of work to describe and characterize the important bacteria of the rumen and to determine their importance in ruminant digestion, attention has been focused on Selenomas ruminatum. Considerable variation exists in the kinds of acids produced by certain strains of this bacterium. Some produce mainly lactic acid while propionic and acetic acids were the predominant acids produced by others. Acids produced by other strains lay between these two extremes. Most strains produced small amounts of butyric, formic and succinic acids. These studies contribute to the knowledge of bacterial factors responsible for the production of nutritionally important fatty acids in the rumen.

Plans

This work will be continued and should be expanded.

3. Factors Affecting Cellulose Digestion in the Artificial Rumen ARS-DH

In studies with the artificial rumen (coop. Mich. Agr. Expt. Sta.) to determine conditions that are favorable to cellulose digestion by rumen microorganisms, it was found that sorbitol increased the total digestion of cellulose from Solka-Floc. Celllobiose, xylose and xylan tended to reduce cellulose digestion. These carbohydrates were without effect when used on a substrate containing alfalfa leaf meal as a source of cellulose. Yeast and pancreatic extracts showed some stimulation of cellulose digestion in the presence of urea and glucose. Inocula from the rumen of a steer fed high levels of cobalt were used to test the effect of cobalt toxicity on cellulose digestion. Cellulose digestion was depressed in timothy hay and cotton linters at the higher levels of cobalt feeding and this effect was accentuated when urea was absent from the medium. Alfalfa leaf meal cellulose digestion was not affected by cobalt in the presence of urea but was depressed in the absence of urea. Four cellulose digesting cultures have been isolated from the rumen of a cow on all alfalfa hay ration and grown on media free of rumen fluid.

Plans

To be continued in an effort to segregate factors affecting digestion of cellulose and utilization of feeds through microbial activity in the rumen.

Publications

The Rates of Cellulose Digestion In Vitro Using Different Sources of Cellulose. R. L. Salisbury, C. K. Smith and C. F. Huffman. J. Dairy Sci. 38: 508, 1955 (Abstract).

4. Synthetic Diets for Calves and Their Requirement for Vitamin B₁₂ and B₆ ARS-DH

Continued work on synthetic diets has resulted in a diet that allows calves to grow at a nearly normal rate up to 10 to 12 months of age. Two calves have been reared to 20 months of age on this diet although growth was distinctly below normal after 10 months of age. Removal of vitamin B₁₂ from this ration reduced the rate of growth. Some B₁₂ was synthesized by the calf under these conditions but not enough to maintain growth. Growth rate was improved when B₁₂ was added back to the ration but the optimal amount necessary to restore normal growth has not been determined. Similarly, growth is markedly reduced, when vitamin B₆ is reduced in this synthetic diet and calves have died at 23 to 150 days of age. Results indicate that calves require a dietary source of vitamin B₆ in the diet. Analysis of B₆ levels in the blood of calves on other rations revealed marked variations.

Plans

Continue development of an improved synthetic ration and investigation of B-vitamin and mineral requirements of calves.

5. Nutritive Value of "Inedible Fats" for the Young Dairy Calf

ARS-DH

The possible use of surplus animal fats in ration for young dairy calves has been examined. Stabilized tallow was incorporated in a calf starter meal at rates of 0, 2.5, 5.0 and 10%. The meal was fed with limited milk and alfalfa pellets to 92 days of age. Calves fed starters containing tallow consumed more nutrients which resulted in 5-6% greater growth. They required less dry matter per pound of gain but total digestible nutrients utilization was not affected. Digestibility and mineral balance studies indicated a decrease in the digestibility of dry matter, organic matter, crude protein and nitrogen free extract and an increase in the digestibility of ether extract in the rations containing tallow. Fecal calcium increased when tallow was contained in the ration. Carotene and tocopherol utilization were unaffected by the inclusion of tallow in the ration. Results indicate that stabilized tallow in amounts up to 10% can be used satisfactorily in the ration of the young calf. The extent to which it may be used would appear to depend on its cost in relation to that of carbohydrate and protein concentrates supplying equal energy. (Work was done under contract with the University of Connecticut.) Work is completed.

6. Magnesium Deficiency or Imbalance in Calves

ARS-DH

Calves on whole milk rations develop magnesium and vitamin E deficiencies. It has been shown that vitamin E deficiency sometimes occurs in young calves under farm conditions. Work during this year has shown the tocopherol (vitamin E) supplementation of whole milk rations did not alter plasma magnesium values of calves nor did it decrease the incidence of uremia, convulsions or ultimate death of these animals. In one experiment the incidence of heart calcification, a symptom usually associated with magnesium deficiency, appeared to be reduced by tocopherol supplementation. Preliminary observations indicate that the utilization of magnesium in alfalfa hay or alfalfa ash was less than utilization of magnesium from a grain mixture. Experiments are in progress to obtain definite information on this subject. Calves fed a whole milk ration plus trace minerals, vitamin D and ample magnesium and tocopherol fail to live to extended periods. Calves fed this ration plus sufficient alfalfa hay live to an advanced age.

Plans

Continue studies on magnesium and tocopherol requirements of calves and their possible interrelation and on factors responsible for failure of calves to survive on whole milk rations.

Publications

Plasma Tocopherol Levels of Dairy Animals Receiving Different Diets.
J. W. Thomas and M. Ikamoto. J. Dairy Sci., 38: 620, 1955 (Abstract).
ARS Information Series 52-12, 1955.

7. Feeding Stilbestrol to Milking Cows

ARS-DH

In spite of the fact that previous attempts to increase milk production with stilbestrol had failed when larger quantities of stilbestrol than have been used with beef cattle were fed, a trial using the same dosage as has been used for beef cattle was run with dairy cows. Stilbestrol was fed at the rate of 10 mg. per day to 6 lactating cows for a 60 day period. Four of these cows were at mid-lactation at the start of the trial and two were near the end of lactation. Three of the cows were fed a ration of alfalfa hay and corn silage and 3 were fed grass-legume silage. All cows were fed a protein concentrate according to milk production.

No detectable effect on milk production as a result of feeding stilbestrol was observed. The normal decline in milk production proceeded without change. There was likewise no change in lactation when stilbestrol feeding was discontinued. The effect of feeding stilbestrol on the digestibility of the alfalfa hay-corn silage ration was determined. There was a tendency for digestibility of the dry matter of the ration to be improved but the difference was not statistically significant.

Thus, in spite of the marked effects produced in beef cattle by feeding stilbestrol at the rate of 10 mg. per day, this procedure has little or no application for increasing milk production of dairy cows.

Plans

An experiment to substantiate this finding is in progress.

B. FORAGE, PASTURE AND SILAGE

1. Alfalfa Silage vs Alfalfa Hay as Feeds for Growing Dairy Heifers ARS-DH

The maximum use of legume or legume-grass silages in rearing dairy herd replacements is an important practical and economic consideration under conditions of intensive grassland farming. Alfalfa silage is inadequate as a replacement for alfalfa hay in the limited milk and grain rations which have been used for rearing dairy heifers. A trial has been completed with seven groups of heifers to determine the amounts of hay or grain needed to balance the alfalfa silage ration in such a way that normal growth would be obtained. The addition of hay or grain to the basic ration improved growth rates although completely satisfactory growth was not obtained with the amounts fed. It is apparent that alfalfa silage is not a satisfactory feed for growing dairy heifers as the only roughage and that hay should also be provided as a part of the roughage ration. The optimal ratio of hay to silage has not been determined. It may be possible to substitute concentrates for hay when silage is the only forage available. The amounts of concentrate necessary have not been determined. This type of modification of the ration would be more costly. Low feed

intake has been a characteristic in all groups where silage was a part or all of the roughage ration.

Plans

Further work to determine the optimal amounts of hay and grain required for use with alfalfa silage in order to obtain normal growth of dairy heifers, and to determine the constituents in alfalfa silage which appear to be responsible for limiting the appetite of heifers for legume silage.

Publications

Comparison of Alfalfa Hay and Alfalfa Silage as a Roughage for Growing Dairy Heifers. J. F. Sykes, H. T. Converse and L. A. Moore. J. Dairy Sci., 38: 1246, 1955. ARS Information Series 52-8, 1955.

2. Factors Controlling Quality in Silage

ARS-DH

Several hundred silages were prepared (coop. Wisconsin Agr. Expt. Sta.) in 1 quart jars in an attempt to determine the correlation between certain factors and silage quality. Alfalfa, brome grass, and a 50-50 mixture of alfalfa and brome grass were the species used. Low organoleptic scores were closely associated with a pH of 5 or above and the presence of butyric acid. No relationship between stage of growth and quality in alfalfa silage was noted but succulent growth of brome grass and the mixture was associated with poor quality. Storage temperatures at 30° and 37°C were associated with poor quality silage from both species and the mixture. Storage at 20°C was most consistently associated with good quality.

The addition of mineral acids (AIV process) molasses, corn meal and whey were all effective in lowering pH. Kylage and sodium metabisulfate were similarly effective with the brome grass and mixed silages but not with alfalfa silage.

An attempt to definitely associate an increase in numbers of any specific group of organisms (including anaerobic sporeformers) with the secondary loss of quality was unsuccessful.

Plans

To investigate the effect on quality of variations in the carbon - nitrogen ratio of the initially ensiled material.

Publications

The Characteristics of Lactate-Fermenting Spore-Forming Anaerobes from Silage. M. P. Bryant and L. A. Burkey. J. Bacteriol. 71:143, 1956.

3. Ensiling and Preservation of High Moisture Silages

ARS ~
DH & AE

The effect of adding Kylage, corn meal, sodium meta-bisulfite or beet pulp to high moisture first cutting orchard grass silage silos was compared to two similar silages made without any treatment. The proximate analysis of the silages to which grain had been added was considerably different with respect to fiber and N.F.E. when compared to the untreated silage. The bisulfite treated silage had a higher pH, carotene and sugar value, was less palatable and somewhat less efficient in preservation of nutrients. The addition of grain, particularly corn meal, produced the most palatable silage. No advantage was observed from the use of an additive material excepting corn meal.

Treatment of high moisture first cutting grass-clover silage with corn meal and with Kylage was compared to an untreated check silage. When compared to untreated silage, corn meal treatment resulted in a higher percentage of total dry matter recovery as well as 92% of recovery of the corn meal. Silage palatability was improved and equal milk production was obtained with a much lower rate of grain supplementation. The Kylage treated silage differed very little from the untreated. Both showed typically low dry matter recovery rates, but values for palatability and chemical quality were higher than is usual in high moisture silage. A comparison between untreated and Kylage treated silage made in 1953 showed considerable advantage for the treatment. These seemingly contradictory results are explained by the marked difference in quality of the untreated silages. Quality level of the check material being a decisive factor in establishing the net effectiveness of a silage treatment.

Chemical results on the high moisture orchard grass and clover silages show little if any improvement in chemical quality of the use of certain additives. The additives used were Kylage, sodium meta-bisulfite, corn meal, and beet pulp. The check silo appeared to be of such high quality that an additive could not improve it.

A comparison of chopped and unchopped second cutting grass-clover mixture stored in two bunker silos, showed the chopped silage to be of higher chemical quality, more palatable, of higher feeding value, and more convenient as regards storing and removing the material. Storage dry matter losses of about 30% marked both silages. The pH of the chopped silage was lower. The carotene preservation in the silos appeared to be good in both cases. The butyric acid content was lower and the lactic acid content higher in the chopped silage.

Plans

Investigations of the relative merits of various preservatives for high moisture silage stored in tower silos and of chopped and unchopped silage stored in bunker silos will be continued. A study of the bacteriological and biochemical characteristics of different types of silage fermentations will be made.

Publications

A Comparison of Chopped and Unchopeed Silages Stored in Bunker Silos. C. H. Gordon, H. M. Irvin, H. G. Wiseman, C. G. Melin, R. J. McCalmont and L. E. Campbell. ARS Information Series 52-19, 1955.

4. Fertilizer Application and Digestibility of Orchard Grass ARS-DH

In studies of factors affecting digestibility of pasture forages, three trials were run in which the digestibility of fertilized and unfertilized orchard grass was compared. In one trial the digestibility of the orchard grass was improved by fertilization to the extent of about 7% and in another by about 1%. In the third trial, digestibility was actually decreased by nearly 4% with fertilization. During the latter trial, a severe period of drought occurred and this appeared to cause a hastening of maturity in the fertilized crop. Results indicate that fertilization will generally increase digestible nutrient yield in orchard grass. However, in dry years the opposite effect may be produced.

Plans

To study factors such as fertilizer application and stage of maturity on yield of digestible nutrients of forages.

5. Pasture Management and Utilization Systems with Grazing Cows ARS-DH & FC

Comparisons of the TDN and dry matter production of orchard grass-ladino clover pasture managed as rotational grazing, daily rationed grazing and soiling, were continued. A constant stocking rate (1 cow per acre) was combined with mechanical harvesting of excess forage as needed, as the method of evaluating forage production. Two pounds of grain per day was fed to all animals. Nitrogen fertilizer as ammonium nitrate, not initially planned, was found necessary because of the lack of legumes in the mixture. Ladino clover was band seeded in the sod in early October, in an attempt to correct this condition.

The greatest total TDN production for the season was obtained from the rationed grazing management, rotational grazing produced slightly less and soiling the least. Strip sampling the plots previous to grazing or harvesting, and dry matter measurements of forage harvested were compared to estimating TDN from animal requirements as a means of measuring pasture production. Large differences between methods were noted. These differences indicated that the results from replicate plots would be more nearly alike if all plots within a treatment were grazed to the same extent. The minimum size of significant differences in yield between treatments can be reduced by attaining greater similarity of results among the plots within each treatment.

While grazing and harvesting of the experimental plots was intermittent depending upon the forage growth available, animal management was held essentially continuous by the use of non-experimental areas. Total seasonal milk production of animals handled under the soiling system was greatest, followed by the rotational grazing group. The rationed grazing group produced the least milk. These differences in production, although sizeable, were statistically non-significant.

The results indicate that in the case of relatively low growing pasture species such as were used, somewhat greater milk production per cow may be attained by the soiling management, but at the expense of less productivity per acre. Mechanical harvesting may be wasteful or the animals on green feeding may enjoy luxury consumption of harvested forage.

Plans

Comparison of these management systems will be continued. Expand research on this and other pasture management systems.

Publications

Permanent Pasture Compared to a 5-Year Crop and Pasture Rotation for Dairy Cattle Feed. J. B. Shepherd, R. E. Ely, C. H. Gordon, C. G. Melin, R. E. Wagner and M. A. Hein. USDA Tech. Bul. 1144, 1956.

6. Comparative Value of Locally Grown Hays in North Carolina ARS-DH

Comparisons of the relative feed value of locally grown hays are in progress at the U. S. Dairy Field Station, Willard, North Carolina (coop. N. C. Agr. Expt. Sta.). Trials were conducted to determine the relation of chopped hay and long hay to hay consumption and growth of young dairy calves, and to compare the relative feed value of oat hay and soybean hay. The summary of these investigations is being compiled.

Plans

Trials of the same design have been initiated to study the relative feed values of oat hay and Coastal Bermuda Grass hay.

7. Influence of the Amount of Grain Fed on the Consumption of Hay and Pasture ARS-DH

Studies of the effect on milk production and nutrient consumption from hay and pasture when grain is fed as a supplement at various rates are in progress at the U.S. Field Station, Huntley, Montana (coop. Mont. Agr. Expt. Sta.). The results of these trials are now being analyzed.

Plans

The trials are being repeated.

8. Carrying Capacity of Pastures

ARS-DH

This study was initiated at Willard, N.C. (coop. N.C. Agr. Expt. Sta.) to determine the carrying capacity of permanent pastures and annual pastures in terms of nutrients produced. In summer grazing trials, a comparison was made of Starr Millet, Pearl Millet, and Sweet Sudan Grass. From the results it appeared that either of the Millets was superior to the Sweet Sudan. On a per-day basis the Pearl Millet appeared to be a little better than the Starr Millet but the Starr Millet carried for 66 days while 50 days of grazing were furnished by the Pearl Millet.

Plans

This study will be continued.

9. Starr Millet a Valuable Annual Forage Crop

ARS-FC

Many favorable reports were received on the performance of Starr Millet, an improved strain of Pearl Millet, developed at Tifton, Ga. Summer drought has caused an increased interest in finding a desirable annual forage crop to supplement permanent or rotation pastures. Starr Millet has been giving good results. Arizona reported that Starr Millet produced silage superior to the commonly used hegari sorghum, while North-Carolina reported that Starr Millet was definitely superior to common Pearl Millet in milk production under grazing. Research conducted at Experiment, Ga., indicated that this strain of Pearl Millet carries a milk stimulating factor, and that it appears to be superior to other summer growing grasses for milk production.

10. Forage Production for Dairy Cows

ARS-DH

This research has been carried out at the U. S. Field Station, Lewisburg, Tenn. (Coop. Tenn. Agr. Expt. Sta.) to determine suitable pasture mixtures and management practices for grazing. An alfalfa-orchard grass mixture grazed rotationally throughout the grazing season produced satisfactory yields over a five-year period. However, this same mixture produced 41 percent more feed nutrients per acre when rotational grazing followed removal of one cutting for hay or silage early in the season.

The results from the use of supplemental irrigation of pasture showed that the distribution of grazing and the yields of orchard grass-ladino clover pastures were profitably improved by irrigation over a four-year period.

Plans

These studies are completed and publications are being prepared. Additional phases of pasture management research are planned.

11. Value of Forages and Pasture in the Northern Great Plains Area ARS-DH

The purpose of these studies was to determine yields and feeding value of various forages and pastures for milk production. They were conducted at the U.S. Field Station, Mandan, N.D. First crop alfalfa-orchard grass was put into a stack silo and fed as a supplement to the native grass pastures during the summer. The group getting the silage as a supplement showed a slightly greater decline in milk production and a slightly greater increase in body weight than the non-supplemented group. Crested wheat grass pasture was grazed once during the spring to obtain additional information on the change occurring when cows are first turned on pasture. The average loss in body weight for eight cows was only 5 pounds per head for the first three days after going on pasture. This was much smaller than the drop in weight the previous year. The cows had been running in a dry lot for about two weeks previous to going on pasture, whereas the year before they were turned directly from the barn to pasture.

Plans

Studies have been discontinued due to the closing of the Mandan Station.

12. Efficiency of Feed Utilization in Dairy Cattle

ARS-DH

This project was established to determine the relative efficiency with which dairy heifers can utilize alfalfa hay for growth and development. It is being conducted cooperatively at the U.S. Field Station, Huntley, Mont., and at the Montana Agr. Expt. Sta. The summary of results showed a wide variation in the consumption of hay by individual heifers. When the efficiencies of the individual heifers were compared, the individual requirement to produce a pound of gain varied considerably and was not closely associated with the age or weight at the time of starting the feeding trial.

Plans

These studies are being continued. In addition limited studies are being initiated at Beltsville to include efficiency data on lactating cows.

13. Pasture Evaluation and Management Practices

ARS-FC

Cooperative studies will be started on pasture species and mixture evaluation involving management studies in the eastern humid region (coop. State Agr. Expt. Stas. and DH).

The objectives of this work are to measure the consumptive intake and output of different pasture plants alone and in mixtures under grazing conditions with different classes of livestock; the grazing and management practice most effective to maintain desirable plant species' balance and season long production; the most efficient and productive

types of pasture for various farm systems and rotations; evaluate various mixtures under irrigation and its effect on stand and production; and the effect of this management for grazing practices on the chemical composition for nutritive value of the forage.

14. Irrigated Pasture Mixtures for the Northern Great Plains ARS-FC

With expanded land areas being brought under irrigation in the Northern Great Plains, there is an increased demand for information on production and persistence pasture mixtures that may be used in this more intensive type of agriculture.

The vigor, hardiness, and persistence of smooth bromegrass and alfalfa make them basic components of pasture mixtures. Orchardgrass is subject to varying degrees of winter injury. The early variety Avon, however, appears most cold resistant. From four harvests, reed canary-grass yielded 20 percent more than smooth brome. Further study is necessary to correctly evaluate reed canary for irrigated pastures. In studies comparing six adapted alfalfa varieties at Upham, N.D., no significant differences in yield were obtained. Pasture mixtures that contained alfalfa were most productive and those with birdsfoot trefoil least productive.

Plans

Work is being continued and expanded.

15. More Productive Irrigated Pasture Mixtures for Dairy Cattle ARS-FC

A study comparing a large number of different pasture mixtures under irrigation over a five year period (coop. Utah Agr. Expt. Sta.) was completed.

The best pasture mixture yielded 56 percent more than the one commonly used for dairy pastures in the Intermountain Region. This new mixture consists of Ranger alfalfa, ladino clover, orchardgrass, southern type smooth bromegrass, and reed canary, as the long lived components; with red clover and tall-oat grass as the short lived components. The pasture yields increased as the number of productive species in the mixture increased. The results of this work do not support a rather world wide movement toward simple mixtures. Farmers who have fertile soil and adequate irrigation water and who will manage intelligently are advised to seed their pastures in early spring, with a companion crop of barley, the barley to be removed as a grain crop which will offset a goodly portion of the pasture seeding and establishment costs.

A mixture of red clover and tall-oat grass are recommended as a one year pasture crop. This mixture should be seeded with a companion crop of barley, which is taken for grain. The mixture can be grazed the following year and any aftermath turned under for succeeding crops.

This work has been completed and results published.

Publications

Grass-Legume Mixtures for Irrigated Pastures for Dairy Cows. George Q. Bateman and Wesley Keller. Utah Agr. Expt. Sta. Bul. 382, March 1956.

16. Control of Wild Garlic and Wild Onion

ARS-FC

Research on the control of wild garlic and wild onion is being conducted in Mississippi, Missouri, New Jersey, and Indiana. In Missouri, repeated treatments of 4 pounds of 2,3,6-TBA per acre resulted in almost perfect control of wild garlic when applications were made about December 1 and in late March. Eight pounds of ATA per acre gave almost equal results, and both 2,3,6-TBA and ATA were considerably superior to 2 pounds of 2,4-D. Legumes would be injured by these treatments. In New Jersey, considerable emphasis has been devoted to extension demonstrations on the control of wild onion with 2,4-D. Wild onion is a major weed problem in this area and 2,4-D is the most satisfactory chemical presently available although it will not completely eliminate the weed in a single treatment.

Plans

Work under way will be continued and will be expanded in Missouri, Mississippi, and Indiana.

17. Weed Control in Establishing Stands of Forage Crops

ARS-FC

Herbicides that promise to give grass and broadleaf weed control in seedling establishment of forage species are now available for experimental use. They offer surer seedings and quicker establishments and they allow for establishment without companion grain crops which in many instances are not desired.

Dalapon has been used in seedling stands of birdsfoot trefoil and alfalfa for weed grass control with only minor injury to these legumes in Missouri, Nebraska, and Indiana. In Missouri, when combined with supplemental mowing for broadleaf weed control, the stand of birdsfoot trefoil was seven times that of the mowed check. The true clovers and lespedeza are injured by dalapon. 4(2,4-DB) has shown much promise for control of many broadleaf weeds in the clovers, and alfalfa with only minor injury to these legumes. Birdsfoot trefoil also shows considerable tolerance to 4(2,4-DB). These two herbicides when used in combinations show promise for weed control in alfalfa and birdsfoot trefoil seedling stands but have doubtful value for the clovers and lespedeza because of the injury to these latter species by dalapon.

In New Jersey, studies on the use of chemicals in pasture renovation have demonstrated their importance in eliminating existing unproductive weedy species. Herbicides which have been most promising include dalapon and ATA. ATA has been more satisfactorily used alone

than has dalapon for the control of broadleaf as well as grass weeds. In Missouri, 4, 8, and 12 pounds per acre of dalapon applied early in the spring have resulted in a high control of bluegrass and other grasses, and good stands of birdsfoot trefoil were obtained when drilled directly in the sod 2 to 3 weeks after treatment. Sixteen and 24 pounds per acre of TCA in the same experiment resulted in enough grass suppression to allow good establishment of birdsfoot trefoil but bluegrass recovered sufficiently in these plots to give a desirable mixture of bluegrass and birdsfoot trefoil one year after treatment.

Plans

Increase the work on control of weeds in establishment of new pastures and renovation of old pastures in New York, Indiana, and Mississippi.

Publications

Promising Chemicals for Seedbed Preparation. A. H. Kates, M. A. Sprague, and R. J. Aldrich. Down to Earth, Vol. 10: 10-11. 1955.

Weed Control in Birdsfoot Trefoil. Harold D. Kerr and Dayton L. Klingman. NCWCC Res. Report 12: 119. 1955.

Control of Grass Weeds in Spring Seeded Alfalfa. M. K. McCarty and P. F. Sands. NCWCC Res. Report 12: 120. 1955.

18. Control of Pasture Weeds

ARS-FC

In Nebraska, annual applications of 1 pound 2,4-D per acre has resulted in a high percentage of control of both perennial and annual weeds. The reduction in dry matter production of weeds has resulted in increased production of more desirable forage almost pound for pound. In the same experiment, plowing and seeding to adapted grasses when accompanied by weed control treatments has resulted in the best weed control and the highest production of desirable forage. This experiment has also shown that proper grazing management has enhanced the benefits derived from the use of herbicides in native pastures.

In Mississippi, bitterweeds in the flower stage were killed with amine salts of 2,4-D applied at 2 pounds per acre, and with no permanent damage to Bermuda grass, dallis grass and white clover. Lower dosage was required when treatments were made at the seedling stage. In Georgia, bitterweeds in the early bloom stage, were more easily killed with a low volatile ester of 2,4-D than with amine salts of 2,4-D and MCPA.

In Georgia, treatments of newly sprigged coastal Bermuda grass with 2,4-D, CIPC, 2,4-DES or 2,3,6-TBA showed promise for controlling weeds in this crop. Similar work in Mississippi showed that 2,4-D and CIPC used pre-emergence were more effective in controlling crabgrass in

Bermuda grass than 2,4-DES or 2,4,5-T and that diuron was damaging to this crop at a dosage of 1½ pounds per acre. In Missouri, weedy brome grasses were removed from a bluegrass pasture by ¼ and 8 pounds per acre of 2,3,6-TBA applied March 9 with little injury to the bluegrass; 12 pounds gave slight suppression of growth. Dalapon at 2,4, and 6 pounds per acre gave good control of weedy brome grasses but resulted in 34, 37, and 92 percent injury to bluegrass, respectively.

Plans

Expansion of the program of weed control in pastures is under way. New research is to be initiated in Georgia, and Mississippi, and co-operative work is less than one year old in New York and Indiana.

19. Farm-Trial Research Farm

ARS-SWC

The dairy pilot farm at Watkinsville, Ga., was enlarged in an attempt to make the farming operation more profitable. The purpose of this study has been to integrate various cropping and soil management operations into a successful small farm dairy enterprise. Several years of study showed this to be impossible unless more land could be devoted to cash crops. On the enlarged farm, forage and feed produced will be utilized by the dairy herd as in previous years, and manufacturing grade milk will be sold as one source of income. Grains and cotton will be other major sources of income. The conversion to the new farm organization will be largely completed in 1956. Parallel terraces will be installed wherever possible to permit maximum efficiency in the use of machinery.

Plans

This work will be continued.

20. Forage Crops Irrigation

ARS-SWC
& FC

Progress was made at Thorsby, Ala., in setting up a regional forage crops irrigation center. Initial data showed that fall seeded forage species could be readily established by irrigation during moisture-deficient fall months. Preliminary information was obtained on the comparative response of different forages to irrigation. Cool season perennial legumes and grasses responded favorably to irrigation in the early summer period, but gave negligible response during the hot, dry, later summer and early fall period in Alabama. Of the species tested, Ladino clover gave the highest total yield and orchard grass the lowest total yield under irrigation. Three times as much forage was produced under irrigation by Star Millet as by ryegrass, oats, fescue or rescue.

Plans

The studies will be expanded.

C. PHYSIOLOGY AND REPRODUCTION

1. Measurements and Mechanisms of Heat Tolerance

ARS-DH

In seeking information which may be used as a guide for breeding programs in areas where heat imposes an important degree of stress on dairy cattle, studies of the measurements of heat tolerance and the mechanisms which are responsible for heat tolerance have been made. Studies under both laboratory and field conditions are in progress at Beltsville and in cooperation with the State Agr. Expt. Stas. of Georgia, Louisiana and Texas.

A total of 215 Jersey and Sindhi-Jersey crosses have been exposed, in a controlled heat chamber at Jeanerette, La., to a standard hot environment of 105°F dry bulb and 34 mm Hg vapor pressure. The initial rectal temperature of the Jerseys and the crossbreds was similar, but the rectal temperature upon exposure for Jerseys rose markedly more than in the crossbreds. The initial respiratory rate of the crossbreds was lower than that of the Jerseys and the rate of the Jerseys rose much more under the hot conditions. It appeared that the reactions of the young animals were inversely proportional to both age and the amount of Sindhi blood in the crosses. Lactating cows showed a more marked reaction than the dry cows, and in general the magnitude of the response was proportional to the level of milk production, particularly in the Jerseys. The indications were that the crossbred cows showed much less effects of heat stress than comparable Jerseys.

Studies conducted at Beltsville on skin evaporation indicated that evaporation from the skin plays an important role in heat loss by the cow under hot conditions and the sweat glands are the main source of the moisture. In studies to determine the acid-base response of selected animals to various temperatures at high and low humidity in the climatic chamber, both Jerseys and Holsteins showed a marked influence on respiratory activity and under severe conditions alkalosis occurred.

A study of the effect of weather conditions on Holstein cattle during the summer months showed that grain consumption was not affected by temperature but there was a marked reduction in roughage consumption with increasing temperature. Silage consumption was not affected as much as hay consumption. The percent solids-not-fat content of the milk decreased at high temperatures. Rectal temperature appeared to have a direct relationship to environmental temperature.

Plans

Studies will be continued on the relation of heat tolerance in heifers to that in lactating cows and the physiological characteristics responsible for heat tolerance.

Publications

A Method for the Analysis and Comparative Presentation of Temperature and Humidity Regimes. D. H. K. Lee, R. E. McDowell, M. W. Schein, and M. H. Fohrman. J. Dairy Sci., Vol. 14, No. 1. Feb. 1955.

Blood Studies of Red Sindhi-Jersey Crosses. III. The Effect of a Fixed Hot Environment on Blood Constituent Levels of Jersey and Sindhi-Jersey Crosses. L. L. Rusoff, M. W. Schein, and J. J. Vizinat. Science 121: 437. (1955).

Rectal Temperature and Respiratory Response of Jersey and Sindhi-Jersey (F₁) Crossbred Females to a Standard Hot Atmosphere.

R. E. McDowell, D. H. K. Lee, M. H. Fohrman, J. F. Sykes, and R. A. Anderson. J. Dairy Sci., Vol. 38, No. 9 (1955).

Rate of Water Evaporation from Various Areas of a Normal Body Surface and with Sweat Glands Inactivated Under Hot Conditions. R. E. McDowell, H. F. McMullan, M. Wodzika, D. H. K. Lee, and M. H. Fohrman. J. Anim. Sci. 14: 1250 (1955).

2. Relation of Body Form in the Growing Heifer to Body Form and Producing Ability in the Cow ARS-DH

This study is to determine the extent to which the body form of the calf and growing heifer may provide a preview of her body form as a cow, and to establish a basis for estimating her future producing capacity. The study is conducted at Beltsville and cooperatively in nine States in the North Central and Southern regions. Current analyses have been concerned with comparisons of Holstein, Jersey and Red Dane females in the Beltsville herd, on the basis of weight, specific body dimensions, variability and rate of approaching maturity in size.

In absolute measurements the Red Danes were midway between the Holsteins and Jerseys in weight, depth of paunch, chest circumference, heaviness of bone and in pounds body weight for each centimeter of chest girth. They closely approximated the Holsteins in body widths, paunch circumference and in length and width of head, but more nearly resembled the Jerseys in height and length of body and in depth of chest. In general, the Red Danes and Jerseys approached maturity with respect to body dimensions slightly earlier than Holsteins, but weight and the various body measurements approached maturity at greatly different rates.

Correlation studies of the body measurements of Holsteins and Jerseys at successive ages with those obtained at maturity showed a high degree of relationship for many of the dimensions, especially the body heights, length of head and body depths. The magnitude of the correlations and their value in previewing or predicting mature body

form increased progressively with advance in age. There was comparatively little difference between the two breeds.

Plans

Plans have been formulated for analyzing the body measurement data obtained by cooperative effort in the field.

3. Interrelationships Between Body Form and Internal Anatomy of the Cow and Her Capacity for Production ARS-DH

This is a study designed to obtain information to provide a better understanding of the significance of body form in relation to performance, and a more reliable basis for the judicious selection of individual cows when production records are not available. The studies have been conducted at Beltsville and cooperatively at 20 widely distributed State agr. expt. stas. The cooperative phase of the work has been discontinued as far as obtaining additional data are concerned. Analyses have been made to provide breed comparisons with respect to absolute averages and variability for each of more than 30 ante-mortem and a similar number of post-mortem items of measurement, and to show the correlation between each ante-mortem and post-mortem item and records of milk production.

The various breeds did not compare to nearly the same extent in absolute measurements of body form as in body weight. For 13 selected body dimensions the percentages calculated to show the relation of each of the other breed groups to Holsteins (the largest breed) averaged 94 for Ayrshires, 91 for Guernseys, 90 for Jerseys, 96 for Red Danes, 94 for Crossbreds and 96 for grade Holsteins. The corresponding percentages for body weight were 85, 77, 75, 89, 86 and 88. The Ayrshires and Jerseys had the deepest chests in relation to their width; the Holsteins the shallowest. The number of pounds of body weight per centimeter of chest girth varied from 5.73 for Holsteins to 5.54 for Jerseys. This may have an important bearing on the accuracy of using tape lines in estimating weight in different breeds as this difference of 1.19 pounds per centimeter would amount to 220 pounds in the estimated weight of a cow measuring 185 centimeters.

Percentages showing the relation of the various breed groups to Holsteins on the basis of 15 selected post-mortem items representing internal anatomical structure were: 89 for Ayrshires, 82 for Guernseys, 78 for Jerseys, 89 for Red Danes and 87 for crossbred cows. Unlike the percentages for body measurements, these percentages did not differ greatly from those for live weight.

Correlations for live weight, hide thickness and 13 body measurements, with records of milk production have been determined. For all of the breed groups combined head length and depth of paunch had the largest number of highly significant correlations. Head width and body length had the next highest number, and width of chest and hide thickness

had the fewest. The Grade Holsteins, Holsteins and Red Danes had the greatest number of highly significant correlations; the Ayrshires and Guernseys the fewest. Similar correlations were determined for each post-mortem item with milk production. For all of the breed groups reported blood weight, stomach weight and kidney weight had the highest number of highly significant correlations. Weights of spleen, pancreas and adrenals had the fewest. The Holsteins and Jerseys had the largest number of highly significant correlations; the Ayrshires and Guernseys the fewest. Among the endocrine glands the pituitary body was most highly correlated with milk production.

Plans

Plans include the completion of the correlation studies of ante-mortem and post-mortem items of measurement with records of milk production; studies of the correlation between the external body measurements and the internal anatomy for each of the various breeds; and an analysis of the accumulation of data on the physical properties of excised udders obtained.

Publications

Weight of Thyroid in Dairy Cows from Different Geographical Areas Within the United States. W. W. Swett, C. A. Matthews and M. H. Fohrman. USDA Tech. Bul. No. 1123. (1955)

4. Studies of Mammary Gland Development in the Calf and in the Cow in Relation to Milk Producing Ability ARS-DH

This is a study of the rate and form of mammary gland development in the calf and of the characteristics of the udder during lactation, which has as its purpose the early identification of the potentially superior animals to be kept for replacement and of the potentially inferior individuals for disposal. Through cooperative arrangements with State agr. expt. stas., Federal field stations and other agencies, a field-test of the reliability of the method is in progress.

A tabulation has been made of the data from herds with production records having 20 or more cows that were graded for mammary gland development at 5 months of age. The animals were listed in 3 groups on the basis of whether their grades as calves were high, medium or low. Of the 25 herds having the required number of animals 11 showed rather definite upward trends in milk production as the grades increased, 4 showed moderate increases, and 4 showed declines. For the others there was no appreciable trend.

Plans

A preliminary machine-analysis of the data now available.

5. Reproduction of Cattle

ARS-DH

Studies in several areas pertaining to reproduction of cattle have continued at Beltsville and in cooperation with State agr. expt. stas. (N. Y., Mass., Col., Wisc., N. J.).

Variations in the amount of growth, thyrotropic and gonad stimulating hormones were found to exist in the pituitary glands of heifers and could be correlated with rate of growth and development of reproductive organs. These differences were not significantly correlated with the level of feeding to which these animals were exposed. This finding offers additional evidence that nutrition may not be an important factor in sterility of dairy cattle except under extreme conditions of nutritional deficiency.

Analysis of breeding data on 69,000 cows in 2,000 herds in New York has shown that breeding difficulty is often associated with breeding cattle too soon after calving and that many dairymen could increase breeding efficiency by waiting for 60-70 days after calving before rebreeding cows.

Work on early embryonic mortality continues to show that differences in uterine defense reactions and in progesterone secretion may be possible causes of embryo loss. In the presence of progesterone the bacteria are not removed from the uterus whereas when the uterus is mainly under the influence of estrogen, bacteria readily disappear. Other experiments indicate that some substance, at present unidentified, which is produced by the uterus may be concerned in the defense mechanism and its production inhibited by progesterone. It was shown that maintenance of the corpus luteum and the production of progesterone is at least partially controlled by the uterus and the possibility exists that some uterine abnormality in repeat breeder cows may alter progesterone secretion and thus alter defense mechanisms in such a way as to increase embryonic mortality.

Plans

Work will be continued.

Publications

Preliminary Observations on the Development of the Normal Bovine Embryo from the Late Blastocyst Stage to the Differentiation of Organ Primardia. J. S. Greenstein and R. C. Foley. J. Animal Sci., 14:1183 1955. (Abstract)

The Effect of Age and Plane of Nutrition on Growth Hormone Content of Pituitary Glands of Holstein Heifers. D. T. Armstrong and W. Hansel. J. Animal Sci., 14: 1242, 1955. (Abstract)

Publications (continued)

Further Studies on Factors Affecting Ovulation in the Cow. W. H. Hough, M. J. Bearden and W. Mansel. J. Animal Sci., 14: 739, 1955.

Conception Rate and Ovarian Function Following Estrus Control by Progesterone Injections in Dairy Cattle. G. W. Trimberger and W. Mansel. J. Animal Sci., 14: 224, 1955.

Effect of Sire and System of Mating on Estimated Embryonic Loss. H. W. Hawk, W. J. Tyler and L. E. Casida. J. Dairy Sci., 38: 420, 1955.

Embryonic Mortality Between 15-34 Days Past Breeding in Cows of Low Fertility. H. W. Hawk, J. N. Wiltbank, H. E. Kidder and L. E. Casida. J. Dairy Sci., 38: 673, 1955.

The Relative Bactericidal Activity of the Uterine and Body Cavities of Estrous and Pseudopregnant Rabbits. H. W. Hawk, J. Simon, M. Cohen, S. McNutt and L. E. Casida. J. A. V. M. A., 126: 268, 1955.

Testicular Biopsy in the Bull. I. Effect on Quality of Sperm. F. X. Gassner and H. J. Hill. Fertility and Sterility, 6: 215, 1955.

Testicular Biopsy in the Bull. II. Effect on Morphology of the Testis. F. X. Gassner and H. J. Hill. Fertility and Sterility 6: 290, 1955.

Effect of Hormones on the Invitro Metabolism of Bull Semen. F. X. Gassner and M. L. Hopwood. Fed. Proc. 14: 484, 1955. Proc. Soc. Exp. Biol. Med. 89, 135, 1955.

D. BREEDING

1. Selecting Dairy Cattle for Solids-Not-Fat

ARS-DH

This study involves the determination of the genetic and environmental influences on the solids-not-fat content of milk. The work is being conducted at Beltsville and cooperatively at the Michigan and Wisconsin Agr. Expt. Stas. Milk samples from cows of several breeds are being collected routinely. Wisconsin compared the Watson lactometer method of determining total milk solids with the Mojonnier gravimetric procedure. The average deviation of the lactometer estimates from the Mojonnier was 0.07 percent. This accuracy is similar to that of the Babcock test for butterfat. Equipment for the field analysis of SNF in a large number of herds has been developed.

Plans

Studies are under way to determine the most feasible procedures for including the test in a breeding program. The portable SNF equipment will be used by at least seven cooperating experiment stations to determine the genetics of this milk constituent.

2. Crossbreeding to Develop Heat Tolerance

ARS-DH

These experiments have been conducted in order to determine to what degree heat tolerance and milk production can be combined by crossing and, if possible, to determine the optimum amount of Red Sindhi or Brahma needed to establish effective heat tolerance for dairy cattle in the South. Crosses of Red Sindhi, Holsteins, Brown Swiss and Brahma with Jerseys have been made at Beltsville and in cooperation with State Agr. Expt. Stas. of Georgia, Louisiana and Texas, as a contribution to the Southern Regional Dairy Cattle Breeding Project.

To date 190 Sindhi crosses have completed one or more lactations. The average milk production of the F_1 Jersey-Sindhi crosses has been less than the average of the purebred Jerseys under the same conditions. The F_2 backcrosses to Sindhi ($3/4$ Sindhi), in general, have been smaller in size and lower in production than the F_1 crosses and the F_1 crosses and the $3/4$ Jersey F_2 crosses have not shown indications of increased milk production over the better of the Jerseys. The results indicate that the $1/2$ and $3/4$ Sindhis have greater heat tolerance than the Jerseys but the backcrosses have not indicated the desired superiority over the Jerseys in milk production to warrant inter-se matings in an effort to fix the characteristics for greater heat tolerance. The performance thus far indicates that Sindhi crosses with Holsteins and Brown Swiss are no better than the Sindhi-Jersey crosses. In all the Sindhi crosses it has been found that temperament is a limitation on the usefulness of the crosses.

Plans

Because of the limited supply of Red Sindhis available for crossbreeding and of the limited results obtained from their use, the solution to the problem of obtaining dairy cattle adaptable to the Southern United States may be found in some other approach. Two approaches which have considerable promise are the development of heat tolerant strains within the existing dairy breeds and the developing of a new strain from crossing the existing breeds. Future efforts will include these studies.

Publications

Dairy Cattle Research at the Iberia Livestock Experiment Station.
M. W. Schein, C. E. Hyde, S. L. Cathcart, and M. H. Fohrman.
USDA Mimeograph, ARS-52-4, April. (1955).

3. Crossbreeding to Increase Milk Production

ARS-DH

These studies were initiated to determine the effectiveness of crossing dairy breeds for increasing the production and efficiency of dairy cattle. The research is in progress at Beltsville, Md., and cooperatively with the Agr. Expt. Stas. of Georgia, Illinois, Indiana and South Carolina, and is contributory to the North Central and Southern Regional Dairy Cattle Breeding Projects.

Forty-one crossbred cows have completed records at Beltsville and in cooperators' herds. Their production in the cooperators' herds has averaged 11,374 pounds of milk, 4.67% butterfat and 525 pounds fat at an average age of 3 years and 4 months. Preliminary results from Illinois indicate that crossbreeding brought about a 5.1% increase in milk production and an increase of 8.4% in butterfat yield. The increase in production appeared to be associated with an increase in size. Matings are continuing as planned at Indiana and South Carolina. A new study was initiated in cooperation with Georgia.

Plans

The Beltsville study will be reorganized to include reciprocal matings of three breeds with emphasis on selection for milk production. Illinois will expand their studies to include milk constituents.

4. The Use of Proved Sires and Their Sons

ARS-DH

This research was established to evaluate the gain in production which can be obtained through the continuous use of proved sires. Also because services from proved sires are not available to many dairymen, studies have been conducted on the production which can be obtained from the use of sons of proved sires. This work has been carried out at Beltsville, in cooperation with the State Agr. Expt. Stas. of Minn., Wisc., Ill., S. C., and Ohio; and at the U. S. Field Stations at Huntley, Mont.; Mandan, N. D.; Lewisburg, Tenn.; Jeanerette, La.; and Willard, N. C.

The principal results for the year were in the Holstein herd at Beltsville. This herd now contains 181 outbred females. Of these, 79 are first generation, 73 are second generation and 12 are third generation progeny of sires from artificial breeding sources. The 52 which have completed records averaged 17,084 pounds milk, 4.04% butterfat and 590 pounds butterfat on 2X, 305 M.E.

Plans

To complete the analysis of the results in the Beltsville herds. Revision of these projects is contemplated.

5. Improved Methods for Proving Sires

ARS-DH

This research was undertaken to develop methods of evaluating the environmental influences on a sire's proving and to determine the feasibility of using selected herds for sire proving purposes. It includes the use of the solids-not-fat test in bull evaluation. The work is being carried out in cooperation with the Agr. Expt. Stas. of Mich.; Minn.; and Wisc.

Information on feed and management practices as well as other environmental influences is being collected routinely from 79 herds in Michigan and Wisconsin. Efforts are being made to record and analyze the data collected by the use of IBM procedures. Minnesota

has been carrying out negotiations with 12 State institution herds regarding cooperation in this project.

Plans

Efforts will be made to expedite the analysis of data now on hand and to establish a breeding structure in the cooperative herds which will yield information on the use of herds with different environmental levels for sire proving purposes.

6. Comparisons of Inbreeding, Linebreeding and Outbreeding ARS-DH

These studies were undertaken to determine the relative effectiveness of inbreeding, linebreeding and outbreeding on methods for improving dairy cattle. They include research at Beltsville, and at the dairy field stations at Huntley, Mont., Mandan, N. D., Lewisburg, Tenn., Jeanerette, La., and Willard, N. C., and in cooperation with the Agr. Expt. Stas. of Minn., Ohio, S. C., and Wisc. These projects contribute to the North Central and Southern regional dairy cattle breeding research.

The breeding programs in all herds continued. The six inbred lines at Wisconsin continued to differ significantly in their ability to withstand inbreeding. For all the lines the average difference between inbreds and outbreds was 79 pounds of butterfat. The first generation inbred females were found to be smaller than the outbred controls as indicated by both weight and body measurements. Differences could not be established between inbred lines in the ability of sperm to survive freezing at 79°C.

Plans

The breeding programs will continue except for the linebreeding comparisons at Beltsville. The cattle in the latter studies are to be moved to Jeanerette, La., for climatic adaptability research.

Publications

Postpartum Estrus and Involution of the Uterus in an Experimental Herd of Holstein-Friesian Cows. N. C. Buch, W. J. Tyler, and L. E. Casida. J. Dairy Sci. 38: 73-79. (1955)

Physical Changes in Young Dairy Heifers as Indicated by Type Evaluation Studies. C. M. Clifton and F. Ely. J. Dairy Sci. 38: 616. (1955)

The Occurrence of Estrus During Pregnancy in Dairy Herds. H. R. Donoho and H. E. Rickard. J. Dairy Sci. 38: 602. (1955)

Effect of Sire and System of Mating on Estimated Embryonic Loss. H. W. Hawk, W. J. Tyler, and L. E. Casida. J. Dairy Sci. 38: 420-427. (1955)

Publications (continued)

Systems of Breeding with Purebred and Crossbred Cattle. J. P. LaMaster, G. W. Brandt, and C. C. Brannon. Annual Report, South Carolina Agr. Expt. Sta. (1955)

Preliminary Report Comparing Cellular Antigens with Type Defects in Dairy Cattle. P. G. Nair, T. M. Ludwick, E. J. Lazear, and L. C. Ferguson. J. Dairy Sci. 38: 615. (1955)

7. Proving Dairy Sires in DHIA Herds

ARS-DH

DHIA lactation records are processed to compile official DHIA Proved-Sire records. The purpose is to identify sires with good inheritance for high production for use in improving the dairy cow population. The sire proving program is a cooperative undertaking between the State Agricultural Extension Services and the Department.

During the year 1955, a total of 5,986 official DHIA Proved-Sire Records were compiled. The daughters of these sires, on an average, produced 10,236 pounds of milk and 415 pounds of butterfat. Copies of the proved sire records are sent to the State Agricultural Colleges, who forward them to the herd owners. Summaries of the proved sire records are also published monthly in the Dairy Herd Improvement Association Letter and given wide distribution. A preliminary study was made to determine the influence that sires used in the artificial breeding studs are having on the production level of the herds enrolled in the artificial breeding program. Herd average data for 524 AB and 747 non-AB herds from twenty different States were included in the study.

A comparison of the rates of increase of the two sample groups of herds shows that AB herds had an average yearly increase of 20.9 pounds of milk and 1.2 pounds of butterfat greater than the average yearly increase of non-AB herds. Further study is needed to determine if the differences observed are the results of genetic improvement or of environmental improvement and also to determine if yearly herd averages are a true measure of genetic improvement.

Plans

Plans are nearing completion in cooperation with the New York Extension Service to study and evaluate various environmental factors influencing production levels. This study is now made possible through the use of the mechanized system of DHIA record-keeping. Under this system, more detailed data will be collected, processed and analyzed more completely than has been possible heretofore.

Progress has been made during the year to adopt the DHIA record processing and compilations of proved sire records to the new electronic-data processing equipment. Personnel has been trained to program and

use the equipment. It is expected that approximately 12 to 15 months will be required to complete plans and procedures for converting to the new system.

Publications

Monthly Dairy Herd Improvement Association Letter, including current list of proved sires, for distribution to State Colleges, County Agents, DHIA supervisors and dairy leaders.

Comparison of Production Levels of AB and Non-AB Herds. Distribution to State Extension Dairymen.

8. Study and Analysis of DHIA Feed and Production Records

ARS-DH

The yearly summary and analysis of DHIA records by States and for the United States, provide dairymen, extension workers and dairy leaders with current information necessary to effectively conduct the Dairy Herd Improvement program. This is a cooperative program between the State Extension Services and the Department of Agriculture.

A new high production average was established by the cows on test in DHIA's in 1955. The summary of more than a million and quarter individual cow records showed that in 1955 the DHIA cows averaged 9,502 pounds of milk and 375 pounds of butterfat.

The tabulations and analyses in this project include pounds of feed, feed cost, value of product, and income over feed cost. Feed cost represents the largest item (about 50%) of expense in the cost of producing milk. Tabulations stressing feed intake for herds of different levels of production serve as a basis for emphasizing the importance of proper feeding in a herd improvement program.

During the year, studies were continued to improve the methods of reporting feed data from local associations and to refine the procedures for computing feed input to a T.D.N. or energy basis. In cooperation with New York Extension Dairymen, methods and procedures are being developed for reporting and processing feed record data as a part of a mechanized DHIA record-keeping system.

Publications

United States summaries of DHIA records are published in the August and September Dairy Herd Improvement Association Letter.

9. The Organization and Operation of DHIA and AB Associations

ARS-DH

The efficient operation of dairy herd improvement and artificial breeding associations has a direct bearing on the success of the general dairy herd improvement program. Continuous studies are made of methods of improving the operation of associations to extend dairy record-keeping and the use of superior sires to more dairy herds.

A new record has been reached this year in the number of cows on test in DHIA's. On January 1, 1956, there were 1,406,306 cows on test, an increase of 5.4 percent over the number of cows on test the previous year and 30 percent over the number of cows on test in 1950. In addition to the cows on standard DHIA test, more than 17,000 herds consisting of approximately 375,000 cows are on Owner-Sampler tests which are conducted for the most part by the local dairy herd improvement associations.

The artificial breeding program has continued to grow during the year. On January 1, 1956, 661,497 herds were enrolled in 1,502 artificial breeding organizations. During the year 1955, 5,413,874 cows were bred artificially. This is the largest number of organizations, herds enrolled and cows bred since the beginning of artificial breeding in this country.

Of the 2,553 sires in AB service January 1, 1956, 932 or 36.5 percent were proved for production. These sires were mated to dams averaging 10,600 pounds of milk and 438 pounds of butterfat. Their daughters on an average produced 11,301 pounds of milk and 477 pounds of butterfat, an increase of daughters over dams of 701 pounds of milk and 39 pounds of butterfat. Each year studies are made in October to show the performance of sires in service in artificial breeding service.

During the year, plans were developed for a new simplified plan of dairy record-keeping in an effort to include more dairy herds on some type of record-keeping program. This new record plan, the Weigh-A-Day-A-Month plan is low in cost, simple to operate, and is especially suited for the owners of small herds. This plan, together with the Owner-Sampler and the standard DHIA plans, makes up the National Co-operative Dairy Herd Improvement program. The ultimate goal of the three plans is to get at least 50 percent of the nation's dairy cows in some dairy record plan within the next decade.

Plans

In a cooperative project with Cornell University, plans, methods, and procedures are being developed to handle and process DHIA records at the county and State level on electronic-data processing equipment. When the system of processing data is perfected, the complete procedures will be published and made available to other States. Three other States are ready to cooperate in establishing similar data processing systems in their areas.

Publications

Dairy Herd Improvement Letter

An annual study and summary of the performance of AB sires is published for distribution to State extension dairymen, AB study managers, and breed associations.

Publications (continued)

Facts About Weigh-A-Day-A-Month Dairy Record Plan.

Project Outline - Weigh-A-Day-A-Month Dairy Record Plan.

Instructions to Dairyman - Weigh-A-Day-A-Month Dairy Record Plan.

Instruction to Computing Service - Weigh-A-Day-A-Month Dairy Record Plan.

Making Dairying Pay - The Record Way. (leaflet)

Project Outline - Owner Sampler Plan.

Instruction to Dairyman - Owner-Sampler Plan.

Suggestion for Calculating Owner-Sampler Records.

E. DISEASES AND PARASITES

1. Brucellosis

ARS-ADP

Further studies on the duration of immunity in cattle vaccinated as calves with Strain 19 have been completed. The 100 cattle vaccinated as calves ranged in age from 2 to 11 years and the 18 non-vaccinated cattle ranged in age from 2 to 5 years. Each animal was exposed to approximately 730,000 viable virulent Burcella abortus organisms by the conjunctival method. This exposure resulted in 18 percent of the vaccinees becoming infected and 13.9 percent aborting; whereas, 83.3 percent of the nonvaccinated controls became infected and 72.2 percent aborted. Frequent periodical bacteriologic and serologic studies conducted on the vaccinated cattle showed that the degree of immunity resulting from Strain 19 vaccination as calves did not decrease with an increase in the age of the animal. These results confirm previous findings, as well as the results of other workers, and points out the fact that revaccination of cattle vaccinated as calves with Strain 19 vaccine is not necessary in the control of bovine brucellosis.

Comparisons were made on the relative immunity to brucellosis induced in cattle vaccinated intradermally at 8 months of age with 0.2 cc of Strain 19 vaccine and on those vaccinated subcutaneously at the same age with 5 cc of the vaccine (coop. N.Y. State Veterinary College). Preliminary results show that 5 of 13 intradermally vaccinated animals aborted as compared to 1 of 13 in the subcutaneously vaccinated group. Virulent Br. abortus was isolated from two other subcutaneously vaccinated cattle that had full term calves. Three of the 4 controls aborted. Virulent infection was demonstrated in all animals that aborted.

A comparison of immunogenicity of streptomycin dependent (S^d) mutants of Br. abortus and Strain 19 for cattle has been completed (coop. Wis. Agr. Expt. Sta.). All of the cattle were vaccinated between 6 and 9 months of age. Following exposure to virulent Br. abortus, 18 of 27 S^d -vaccinated cattle aborted with 20 becoming infected; whereas, only 8 of 27 Strain 19-vaccinated ones aborted with 14 becoming infected. Twelve of the 20 nonvaccinated controls aborted and 15 became infected. These results do not recommend the use of S^d vaccine for the practical immunization of cattle against brucellosis.

Comparisons were made of the effect of four different adjuvants combined with ether-killed Br. abortus vaccines on guinea pigs (coop. Univ. of Pa.). Local reactions of guinea pigs inoculated intramuscularly with each of the adjuvants had disappeared at the end of four months. Vaccine containing Falba produced the highest average agglutinin titers and that containing Arlacel A produced the lowest ones. Although there was considerable variation of immunity within each vaccinated group, the guinea pigs in the Falba-vaccinated and Arlacel C-vaccinated groups showed the best protection.

Studies have been continued on a seroagglutination test with a modified incubation temperature and time to differentiate between specific and nonspecific blood serum agglutinins for Brucella. This test properly identified 33 bacteriologically proven infected cattle and 48 of 49 bacteriologically proven Brucella-free animals, all of which had blood serum titers of 1:25 or higher. In the one case of possible failure the character of the reaction was indefinite. The 82 cattle were represented by both calf-vaccinated adults and nonvaccinated animals which had been exposed previously to virulent Br. abortus.

Additional studies were conducted on 202 vaccinated and nonvaccinated cattle with seroagglutinin titers of 1:50 or higher by testing their blood serum for specific agglutinins with the modified seroagglutination test. The brucellosis status of the cattle was initially established by testing their blood serum, and by examining their milk bacteriologically. The modified seroagglutination test classified 17 of 21 animals considered infected as having specific agglutinins for Brucella in the blood serum; whereas, it classified 175 of 181 considered as non-infected as having nonspecific agglutinins for Brucella.

Work has been continued on the use of acidified plate test antigens in the field to differentiate between specific and non-specific bovine serum agglutinins for Brucella (coop. Minn. Agr. Expt. Sta.). Four antigens of different acidity (pH 4.2, 4.0, 3.7, 3.4) were employed. There was a direct correlation between the reduction of suspicious titers in the blood serum of nonvaccinated cattle in the suspect herds, and the acidity of antigens in that the percentage of suspicious titers receding to negative progressively increases as the acidity of the antigen is increased. In a 60-120 day retest of 138 suspects with the standard seroagglutination test only 2 of 104

that were negative to an acidified plate antigen became reactors. Of the 34 suspects that were positive to the same acidified plate antigen, 38 percent became negative, 32 percent remained suspects and 30 percent became reactors on retest. Both nonvaccinated and calf-vaccinated adults having suspicious titers and whose blood serum had been subject to an acidified plate antigen were retested in 60-120 days with the standard seroagglutination test. There was a marked similarity in the percentages of the acidified plate antigen, negative vaccinees and non-vaccinees that became negatives, suspects, and reactors. Of those that were positive to the acidified plate antigen, none of the vaccinees and 6.4 percent of the nonvaccinees became reactors. These results are additional evidence that the granting of one full dilution tolerance in the agglutination titer for calf-vaccinated adults was justified.

In a comparison of a 30 minute vs. a 60 minute incubation at 37°C. of the milk ring test on composite can samples, the 30 minute incubation period reduced the sensitivity of the test approximately 75 percent on $\frac{++}{++}$ reacting herds and 25 percent on $\frac{+++}{+++}$ reacting. There was not any significant difference in sensitivity on $\frac{++++}{++++}$ reacting herds. This finding is significant because false reactions are greatest in the lower reacting samples. The results of incubating bulk tank samples (greater dilution factor) for 60 minutes are similar to those of incubating composite can samples (3 cans) for 30 minutes.

Investigations to evaluate the milk whey plate test for the diagnosis of brucellosis in individual lactating cattle is nearing completion (coop. Calif. Agr. Expt. Sta.). In animals uncomplicated with adult vaccination, there was 97 percent agreement between the milk whey plate and blood serum agglutination test. It is highly probable that the milk whey plate test could be substituted for the seroagglutination test in dairy areas where types of management justify its use.

Plans

Studies will be continued to develop and improve tests for differentiating between nonspecific and specific agglutinins for *Burcella* in the blood serum and milk of cattle. A thorough search also is being made of the mechanism by which Strain 19 produces immunity in cattle against brucellosis.

Publications

The Diagnosis of Brucellosis of the Mammary Gland by a Serologic Milk Test. Preliminary Report. H. S. Cameron and J. W. Kendrick. Proc. U. S. Livestock Sanitary Assn. Fifty-Ninth Annual Meeting, 1955.

A Whey-Plate Test for the Diagnosis of Bovine Brucellosis. H. S. Cameron, J. W. Kendrick and R. W. Merriman. Jour. Amer. Vet. Med. Assn., Vol. 129, No. 1, July 1956.

Brucellosis. C. A. Manthei, A. K. Kuttler and E. R. Goode. Yearbook of Agriculture 1956.

Publications (continued)

Effect of Various Adjuvants Upon Ether-Killed *Brucella abortus* Vaccine. I. Live. *Bact. Proc.* 1955.

2. Leptospirosis

ARS-ADP

The studies during the past year have dealt primarily with growth requirements, cultural characteristics, and seriological testing methods.

Evaluation of four currently employed *Leptospira* media shows rabbit serum to be superior to cow, horse, and swine serums, however, preliminary data points to nutritional variations in different lots of rabbit serum. Because of the inherent difficulties associated with purchasing commercial rabbit serum, a search is in progress for a substance to replace rabbit serum which would produce at least an equal level of growth. At the present time no complete substitute for rabbit serum has been found.

Other manipulative procedures have been carried out to increase and improve antigenicity of *Leptospira pomona* and decrease extraneous particulate matter. Further studies are planned to develop methods of eliminating or minimizing the development of periodic clumping and its apparent interference with multiplication.

Preliminary studies on standardization procedures and test agents employed in the agglutination-lysis test are in progress. Limited results suggest that younger *Leptospira* antigens and shorter incubation time than are now employed by most investigators can be used.

Plans

Present studies will be continued. Research will be initiated to standardize present diagnostic tests and develop a more practical one.

Publications

Leptospirosis. G. B. Van Ness and C. A. Manthei. U.S.D.A. Yearbook of Agriculture, 1956.

3. Vibriosis

ARS-ADP

Various routes of exposure with known infectious material have been used to determine possible methods of spread of vibriosis in cattle other than coitus and artificial insemination. The routes of exposure employed were conjunctiva, alimentary tract, skin, vagina, prepuce, and intravenous. The types of infectious material used were vaginal mucus, semen, and both recently isolated and laboratory cultures of *Vibrio fetus*. None of the cows exposed per os, by the conjunctiva, and on the skin became infected, regardless of the type of infectious material employed. Although infection has been produced in the past by intravaginal exposure with recently isolated cultures of

V. fetus, it was not possible to repeat those results with a V. fetus culture maintained in the laboratory for a prolonged period. The only cows that became infected were those exposed intravenously with a suspension of a recently isolated culture. In addition, only 1 of 4 bulls was infected by injection of a suspension of V. fetus cultures into the prepuce. Two other bulls exposed by the same method with infectious vaginal mucus failed to develop vibriosis.

Work has been continued in following the course of vibriosis by cultural diagnosis in all females in a herd bred by natural service to both infected and non-infected bulls. The use of a known infected bull was discontinued on all females assigned to him after completion of their second or third pregnancy. Four other animals were bred once each for their second gestation by the infected bull but failed to conceive. After a three month or longer interval, they were rebred to a young non-infected bull. All other cows formerly bred to the infected bull were also bred to the non-infected bull for their succeeding pregnancies. V. fetus has not been isolated from the herd since inauguration of this breeding program. During the course of over four years of observations, V. fetus did not spread by contact from infected to non-infected females.

A V. fetus antigen has been developed for testing bovine vaginal mucus for agglutinins similar to that used for testing blood serum for brucellosis. Vaginal mucus collected from commercial herds suspected of being infected has been used to determine the efficiency of the test. In herds using natural service, vaginal mucus was obtained from females bred 60 days or longer both for cultural and agglutination purposes. In all herds where V. fetus was isolated, one or more females bred 60 days or longer were positive to the vaginal mucus agglutination test. Of 17 herds found positive to the vaginal mucus agglutination test, V. fetus was isolated from 13; whereas, 11 other herds found negative upon culture were also negative to the agglutination test.

Studies are in progress to determine the relationship of colonial characteristics to pathogenicity and antigenicity of various strains of V. fetus. Several colonial forms have been observed but it has not been possible to consistently reproduce them because of their extreme instability in media presently employed. Until this is accomplished there is little hope of consistently producing infection with cultures or developing an antigen for detecting specific antibodies for V. fetus in the blood serum of cattle.

Plans

Continue studies of the colonial characteristics, antigenicity and pathogenicity of strains of V. fetus, methods of transmission of vibriosis in cattle and diagnostic procedures.

Publications

The Pathogenicity of Vibrio Found in the Reproductive Tracts of Cattle. A. H. Frank, J. H. Bryner and B. Caruthers. Presented at Third International Congress on Animal Reproduction. Cambridge, England. June 25-30, 1956.

Vibriosis of Cattle. A. H. Frank. Yearbook of Agriculture, 1956.

4. Mastitis of Cattle

ARS-ADP

Studies were continued on determining the factors in milk which influence acid production by Streptococcus agalactiae. The proteins alpha lactalbumin and betalactoglobulin were isolated from whey by a method utilizing ammonium sulfate. These proteins were added to raw and heated milk singly and together in amounts which approximate those normally found in milk. No evidence was obtained which would indicate that either of these proteins influence the production of acid by Str. agalactiae in raw or heated milk.

The serial dilution of raw milk with heated milk confirmed the findings that acid production by Str. agalactiae is apparently influenced by stimulatory and inhibitory factors in the milk. The manner of heating the milk used for diluent was found to influence the results of the titration. Milk heated in a sterilizer gave different results than milk heated in an autoclave. The method of testing milk for its resistance to the activity of Str. agalactiae by measuring the amount of acid produced at the end of 24 hours must be considered as measuring a balance between both stimulatory and inhibitory factors until it can be shown that an increase in acid production is the result of a decrease in the concentration of inhibitory factors rather than an increase in the concentration of stimulatory factors.

The method for measuring resistance of milk samples to mastitis-producing hemolytic staphylococci (Micrococcus pyogenes), that is based on oxidation-reduction potential changes, was utilized weekly throughout the year (Ohio Agr. Expt. Sta.). Weekly samples from approximately 15 cows were exposed to the action of the organism and hourly checks made to determine the time required to reach the point that methylene blue began to discolor. Consistent variations have been noted between cows. Trends in the average of the groups of cows have varied from season to season with the resistance being relatively higher during the winter than the summer in two out of three years. This was true both in cows fed only a hay and grain diet all year and those receiving pasture and, or, silage. However, these two groups did not follow similar patterns.

A search has been continued for substances that are capable of being fed to cows and later secreted in their milk to give the latter increased resistance to mastitis-producing bacteria. One that appeared promising was menadione. Results indicate that no effect was accomplished on Str. agalactiae either directly in vitro or by feeding it to cows.

On the other hand, when fed to 10 cows the average resistance of their milk samples to M. pyogenes showed a gradual yet considerable increase for 3 weeks. A field study was then carried out in a herd which had udder infection with M. pyogenes. At first there were indications that the 10 cows receiving menadione were producing more resistant milk than the controls. Later, however, this did not appear to be the case, but it should be noted that during the latter period all cows in the herd were relatively resistant. No clinical mastitis was occurring although nearly every cow in the herd was infected.

Plans

This work is continuing in the event a period of low resistance is encountered so that some data can be obtained indicating whether resistance can be maintained although it may not be raised above the normal levels. A third test is aimed at determining if variations in resistance of milk occur to coliform organisms that are associated with mastitis.

Publications

The Resistance of Milk Samples to the Activity of Streptococcus Agalactiae as Affected by Pasture. W. D. Pounden, Norma A. Frank, and W. C. Krauss. Amer. J. Vet. Res., 17, 227, 1956.

The Resistance of Milk Samples to the Activity of Streptococcus Agalactiae as Affected by Feeding Silage. W. D. Pounden, Norma A. Frank, R. W. Brown, and R. K. Scherer. Amer. J. Vet. Res., 17, 231, 1956.

Bovine Mastitis. R. W. Brown. USDA Yearbook of Agriculture, 1956, p. 245.

Mastitis Detection, Transmission and Control

ARS-DH

These projects were originated to identify the organisms which cause mastitis, the frequency of their occurrence, their sources, and the paths of transmission and to develop effective management methods for their control. The studies were expanded this year to include cooperative work with the North Carolina Agr. Expt. Sta. The predominant infective organisms in the Beltsville herd during the past few years have been coliform bacteria, hemolytic staphylococci, S. uberis and Pseudomonas. Detailed studies were begun on the coliform bacteria to determine their detailed identity. Results to date show that coliform mastitis may be caused by at least 3 species of organisms: Escherichia coli, which is the same as the organism in calf scours; Aerobacter aerogenes; and a group which is similar but not identical to A. aerogenes. Limited observations indicated that the barn environment as well as the cow may be important reservoirs of mastitis infection.

Plans

Detailed studies of coliform mastitis organisms will be continued. Genetic influences on susceptibility to infection will be carried out at North Carolina State College. Efforts will be made to develop more exacting methods of determining the influence of barn environment on infection.

5. Paratuberculosis (Johne's Disease)

ARS-ADP

Studies have been conducted on the production of allergy in cattle injected with a killed Mycobacterium paratuberculosis vaccine. Postmortem examination of vaccinated animals shows that a mineral oil suspension of the bacteria does not cause the Mycobacterium to be retained at the inoculation site. The organisms are carried to a number of lymph glands of the body where they can be demonstrated for as long as four months but less than seven months post-vaccination. Removal of the vaccination site caused a loss in allergy in about one year.

Comparisons were made of the microscopic demonstration of M. paratuberculosis in specimens, hemagglutination (HA) test of blood sera, and intradermal Johnin test of cattle suspected of having Johne's disease. Of 38 animals, small acid-fast bacilli were demonstrated in 15. Eight of the 15 were positive to HA and Johnin tests; five were negative to HA and positive to Johnin, one was positive to HA and negative to Johnin, and one was negative to both tests. Of the remaining 23 animals which were negative for acid-fast bacteria, 16 were positive for Johnin and negative for HA, and seven were positive for both tests. Neither the intradermal Johnin nor the hemagglutination test was in complete agreement with the microscopic findings, and both tests were in agreement on only 42 percent of the cases.

In studying the hemagglutination test, bovine erythrocytes were investigated as a possible substitute for sheep erythrocytes in hemagglutination tests on bovine sera, and also to determine if there were any differences in erythrocytes from normal animals and from paratuberculosis or tuberculosis infected animals insofar as their ability to become sensitized with either Johnin PPD or tuberculin PPD was concerned. It was found that erythrocytes of 49 percent of the animals could not be sensitized. It did not appear to make any difference if the animal from which blood was obtained was normal or infected with either tuberculosis or Johne's disease.

Plans

Continue studies on development of a reliable serological test, and on immunization against Johne's disease.

Publications

The Present Status of Our Knowledge of Johne's Disease. A. B. Larsen. Proc. U. S. Livestock Sanitary Assn., 1955.

Paratuberculosis (Johne's Disease). Aubrey B. Larsen and Howard W. Johnson. Yearbook of Agriculture 1956.

6. Tuberculosis

ARS-ADP

Continued research with serological tests for the diagnosis of tuberculosis shows that the modified hemolytic (HM) was more sensitive than the hemagglutination test (HA) on tuberculin reactors, both lesion and no lesion cases. The differences in the two tests were slight on animals negative to the tuberculin test and from tuberculosis-free herds. Testing of blood samples from a number of the same cattle with the complement-fixation test showed very little correlation between results of it and those of tuberculin test and post-mortem findings.

The HM and HA tests appear to have the most value in detecting cattle having long standing lesions than in those having recently developed lesions. The former animals are usually associated with problem herds and the latter ones with herds where tuberculosis is spreading rapidly. Evidence indicates that recently infected animals have not had time to develop detectable antibodies in the blood, but fortunately most of them are detected with the tuberculin test.

Plans

Continue evaluation of the HA and HM tests with emphasis on its use in problem herds. Application of a flocculation test which some workers claim will identify more than 90 percent of the animals having tuberculous lesions.

7. Anaplasmosis

ARS-ADP

Research investigations on large scale production of anaplasmosis antigen was continued to study the problems of large volume production lots not encountered in small experimental lots, and to provide a supply of antigen needed to meet the demands of a rapidly expanding testing program. At present, antigen is not available from any other known source. Antigen was produced from 130 head of cattle, 85 percent of which were mature animals and 15 percent were splenectomized calves. Two types of antigen were prepared from most animals. Seventy percent of the antigens produced are satisfactory for use, the remaining 30 percent will be carefully screened for reprocessing. A total of 82,840 test doses of antigen were shipped to laboratories in States and Territories.

Infectivity information has been developed which may be the solution to practical field control and eradication programs. It has been demonstrated that the infectivity level in an animal may be determined by

measuring the animals antibody level with the complement-fixation test. It was also shown that series of positive test calves receiving the same donor blood but tenfold differences in dosage for each animal, resulted in a definite pattern of longer incubation periods and lower parasite counts in the blood of the test calves for each successive tenfold decrease of the infectious dosage.

Calves born from positive reacting dams frequently developed a positive reaction. Calf inoculation tests from these reactor calves were negative and the positive serological reactions became negative after a few weeks. These results indicate transfer of the disease antibody from the infected dam to the offspring, without transfer of infection, through colostrum and milk for the first few weeks of the calf's life. A marked difference in the natural resistance to anaplasmosis was observed between the common dairy breeds of this country and crossbred Sindhi animals, as measured by heavy challenge exposures used on 110 adult cattle. Animals with Sindhi blood were the more resistant.

Anaplasmosis herd incidence surveys were made on 19 herds containing 4802 cattle from Montana, Tennessee, Texas, Oregon, Pennsylvania, Ohio, and Washington. 16.8 percent were positive; 7.5 percent were suspicious; and 75.7 percent negative. There were 3248 cattle tested in California, Washington, Oregon and Arizona containing 115 positive, 80 suspicious and 3053 negative. The negatives were for export to Hawaii in connection with anaplasmosis test and slaughter field trial eradication program.

Serological technicians from Virginia, Wyoming, Oregon and Louisiana were given a course of special training in preparation for developing their own testing laboratories. One infected herd in Virginia has eradicated the disease in 3 years by using a program of test and segregation of reactors from negative animals. Another Virginia beef herd of 3200 head, with a low incidence of reactors in 1955, was kept under observation for one year to determine the natural rate of disease spread. Only 9 new reactor animals were found. All reactors were removed from this herd in 1956 and the herd was closed to any imports.

Plans

Plans are under way for additional cooperative field trial eradication studies with herds in Tennessee, Louisiana, Texas, Virginia, Washington, and Oregon. Cooperative work with ENT on infectivity studies in ticks, and insecticide disease control studies, is also planned.

Publications

The Status of the Complement-Fixation Test for the Diagnosis of Anaplasmosis in 1955. D. W. Gates and T. O. Roby. Annals of The New York Academy of Sciences, Vol. 64, p. 31-39, July 1956.

Publications (continued)

Anaplasmosis of Cattle. John C. Lotze, D. W. Gates, and T. O. Roby.
The Yearbook of Agriculture 1956

8. Vesicular Stomatitis

ARS-ADP

Prior to 1952 vesicular stomatitis (V.S.) was observed to occur naturally only in cattle and horses. During the last five years initial outbreaks of New Jersey type V.S. occurred each spring in swine on the Gulf Coast and coastal plain areas of the Southeast. Three strains of New Jersey type V.S. virus of cattle origin, isolated in 1949 from Arizona, Texas, and Wyoming, were compared with 9 strains of swine origin virus of the same type collected in 1952-55 to determine if some changes could have taken place in the virus. Virus comparisons were made serologically by complement-fixation and serum neutralization, immunologically by virus cross challenge and by species susceptibility tests on swine, guinea pigs, chickens, and fertile hens' eggs. No measurable difference could be demonstrated between cattle and swine origin virus except the cattle origin virus strains were more easily adapted to chicken eggs.

A practical and valuable serological diagnostic and typing procedure was developed and is now being routinely used on sera from cattle where it is suspected a vesicular disease has occurred but no virus can be found. The testing procedure combines the use of two previously developed tests, complement-fixation and serum neutralization tests on unknown sera. This testing procedure will identify past infection with V.S. It will identify the type of virus the animals were infected with and it gives information on the approximate time the disease occurred. It is a valuable instrument for confirming a V.S. diagnosis where foot-and-mouth disease was suspected and previously a diagnosis could not be made.

Vesicular stomatitis virus of both New Jersey and Indiana types from cattle origin have been successfully adapted to swine kidney tissue culture cells. Serum from cattle which has previously been infected with V.S. of New Jersey or Indiana type was then used in combination with tissue culture adapted virus of each type, following which, tissue culture cells were inoculated. These serum neutralization tests although limited in number were successful and compared favorably with parallel control neutralization tests made in fertile chicken eggs.

9. Mucosal-Respiratory Diseases-Complex of Cattle

ARS-ADP

Cooperative work is being expanded on the influenza-like disease of California, the rhinotracheitis of Colorado, the mucosal disease of Iowa, the mucosal disease of Indiana, the virus diarrhea of New York, and the virus diarrhea of Indiana. The California influenza-like disease of dairy cattle and the Colorado rhinotracheitis or "red nose" have been experimentally produced with nasal washings and have similar symptoms. Studies were made on the lesions and pathology. In order to demonstrate the immunologic relationships between California and

Colorado outbreaks, calves recovered from experimental infections with California material and calves recovered from Colorado material were injected with Colorado material. None contracted the disease, strongly suggesting both diseases were caused by the same type of virus, alike immunologically. Observations are continuing on the duration of immunity. This disease has been diagnosed in 15 States.

Work on virus diarrhea of Indiana and virus diarrhea of New York (Ind. Agr. Expt. Sta.) indicates these two diseases appear to be caused by two immunologically different types of virus which were both different from the Colorado and California respiratory diseases. Extensive investigations have been conducted on the virulence, pathology, and symptoms of virus diarrhea. Virus from outbreaks in the California influenza-like disease, in the Colorado rhinotracheitis, and in the Indiana virus diarrhea was successfully grown in tissue culture, the former by California and the latter by Indiana. This constitutes a definite isolation and proof of viral etiology as well as the provision of a satisfactory method of virus propagation in the laboratory. Mucosal disease of Indiana is being extensively studied (Ind. Agr. Expt. Sta.) with considerable progress toward the finding of a cause and some predisposing causes.

A reference or bank laboratory for typing of viruses isolated from cases of mucosal diseases and virus diarrheas of other States was cooperatively established (Ind. Agr. Expt. Sta.) and one for rhinotracheitis and influenza-like diseases (Colo. Agr. Expt. Sta.). In work at Colorado on the immunological response of cattle from different routes of inoculation with different materials, the intramuscular inoculation of virus material from nasal washings produced a better immunological response than other routes and materials.

Plans

Research will be expanded along the lines of immunological studies, kinds and types of viruses in the influenza-like disease of dairy cattle, red nose, rhinotracheitis, and virus diarrheas. Work will be initiated on the cause or causes of the mucosal disease of Iowa and expanded on the mucosal disease of Indiana.

Publications

Mucosal Disease Complex. ARS Special Report No. 22-27, pp. 1-9, June 1956.

Recent Development on Upper Respiratory Disease of Cattle. D. G. McKercher, J. E. Moulton, J. W. Kendrick, and J. Saito. Proc. U. S. Livestock Sanitary Assn., pp. 151-167, Nov. 1955.

Infectious Rhinotracheitis in Cattle. I. Pathology and Symptoms. Rue Jensen, T. L. Chow, and W. W. Brown. Proc. U. S. Livestock Sanitary Assn., pp. 189-199, Nov. 1955.

Publications (continued)

Infectious Rhinotracheitis in Cattle. II. Experimental Reproduction. T. L. Chow, A. W. Deem, and Rue Jensen. Proc. U. S. Livestock Sanitary Assn., pp. 168-172, Nov. 1955.

Infectious Rhinotracheitis in Cattle. III. An Epizootiological Study. T. L. Chow, J. L. Palotay, and A. W. Deem. Jour. Amer. Vet. Med. Assn., Vol. 128, pp. 348-351, April 1956.

The Mucosal Diseases of Cattle - Epizootiology, Symptomatology, and Experimental Studies. W. R. Pritchard. Proc. Amer. Vet. Med. Assn. 92, pp. 37-42, 1955.

Virus Diarrhea and Mucosal Disease. W. R. Pritchard, R. G. Carson, H. E. Moses, and D. E. Bunnell Taylor. Proc. U. S. Livestock Sanitary Assn., pp. 173-188, Nov. 1955.

A Transmissible Disease Affecting the Mucosae of Cattle. W. R. Pritchard, Doris Bunnell Taylor, H. E. Moses, and L. P. Doyle. Jour. Amer. Vet. Med. Assn., Vol. 128, No. 1, pp. 1-5, Jan. 1956.

10. Ruminant Bloat

ARS-APH
& ADP

Extensive studies on ruminant bloat have involved the use of both sheep and cattle and has involved direct cooperation with WU, ADP and FC of ARS, and with the New York State Veterinary College and the Calif., Md., Minn., Miss., and Wis., Agr. Expt. Stas. Progress can be reported on the following phases of the work:

(a) Physiological Studies

This is a study of the relationship of eructation, nerve supply and physiology of the bovine forestomachs, bloat-producing substances in legume plants, and the stomach contents of bloated cattle to the cause of bloat, cause of death therefrom, and of decreased milk production in bloated cows. Work has continued on determination of the anatomy, innervation, and physiology of the normal forestomachs of unanesthetized adult cows surgically prepared with two sets of electrodes on the dorsal trunk of the vagus nerve. Progress is being made toward gaining a fundamental understanding of the innervation and motility patterns of eructation in normal cattle and the possible causes of abnormality of these. The mechanics of eructation and the nervous influences thereof are being studied using electric stimuli, five drugs, and alfalfa saponin. The rumen wall around the cardia is rich in receptors which stimulate eructation and also in receptors which inhibit eructation. Three branches of the vagus nerve have been found to supply the esophagus at varying levels and also the sphincters of the esophagus. Organic acids have been isolated from alfalfa which produce "bursts" of gas as they are

decarboxylated by paunch organisms. Bloat was produced experimentally in dairy cattle by drenching with dehydrated, ground alfalfa and fresh egg white, suggesting the soluble protein content of forage may be a factor. This type of induced bloat results from the accumulation of foamy ingesta and was experimentally prevented by a small amount of vegetable oil. Severe bloat was produced in dairy cattle by feeding fresh green chopped alfalfa and it was found the addition of a small quantity of vegetable oil to this prevented bloat. Five legumes, grown on the same soil type with the same fertilizer treatment, were clipped and fed to cattle. White, Dutch, crimson, and Persian clover were fed in the full bloom stage and red clover and alfalfa in the pre-bloom stage. An effort is being made to determine the bloat index of this group of legumes. Radioisotopes are now being used by which an improved and precise technique has been developed for studying rumen bacterial metabolism based on C^{14} labeled substrates. A simplified concentrate from other than natural feedstuffs was developed which is similar to the chemical composition of a bloat-producing concentrate. This diet produced chemical changes of a similar order to that of the bloat-producing diet, but not the frothiness or the increase in the degree of encapsulation of rumen bacteria. Since these cattle have been receiving about the same amount of alfalfa hay as the animals on the feed lot, bloat-producing diet, this suggests strongly that certain factors exist in barley and/or soybean oil meal other than starch and protein which are necessary for bacterial encapsulation and froth production.

(b) Pharmacological Studies

Studies have been conducted to determine the effect of administration of alfalfa saponin to sheep. Bloat symptoms have been produced in sheep following intraruminal and intravenous administration of the saponin under appropriate conditions. It has been shown by physiological and pharmacological studies that intravenous administration of the alfalfa saponin (1 g. doses) can: (1) Prevent eructation (belching) in sheep by its actions on the esophagus and other organs; (2) cause lack of rumen tone; (3) have a pronounced effect on the respiratory center and can cause respiratory failure; (4) affect heart action and blood pressure; and (5) result in toxic effects other than those listed above. Intraruminal administration of large doses of alfalfa saponin to sheep (50 g.) results in similar effects. Smaller doses (15 to 30 g) results in reduced ruminal motility in some sheep and has little apparent effect in others. Administration of 1 gram of the alfalfa saponin into the duodenum of sheep results in an immediate cessation of all rumen motility except that associated with eructation. It has been possible, therefore, to separate the contractions of the rumen that are associated with eructation from those associated with mixing of the rumen contents. With this and other techniques it has been shown that the rumen contractions associated with eructation are stimulated by gas pressure rather than by the presence of fibrous material and that apparently these contractions are controlled by different nerve impulses or by a different nerve network than the regular

contractions. Legume press juices have been shown to effect ruminal motility in a manner similar to that of alfalfa saponin, however, some saponins isolated from non-legumes have not affected ruminal motility.

In-vitro studies indicate that alfalfa saponins may play an important part in the formation of and the stabilization of frothy ruminal contents, but that other factors are necessary for the production of frothy bloat in addition to the saponin. Mild experimental "frothy" bloat has been produced in sheep by the use of legume press juices and by the use of a combination of water soluble protein, alfalfa saponin and plant sugars. Observations during this type of experimental bloat have indicated that the ruminal contractions associated with eructation increase in frequency and even in strength while the "major" ruminal contractions can be markedly reduced in strength. The gross and histological lesions resulting from toxic levels of alfalfa saponin have been determined in sheep.

(c) Fermentation in the Rumen

There was some expansion of the basic fundamental work on bloat of ruminants (coop. California, Cornell, Maryland, Minnesota, Mississippi, and Wisconsin Agr. Expt. Stas.). Radioisotopic studies have been applied for the first time to bloat studies on the fermentation in rumens of bloated animals and an artificial heart and lungs have been developed for physiological studies connected with bloat. The efferent nervous influences of the entire esophagus, including the sphincters, have been worked out with decerebrated sheep. The effects of changes of the position of the sheep on the process of eructation have been determined. Some basic work has been done on the isolation from alfalfa of organic acids which produce "bursts" of gas as they are decarboxylated by paunch organisms. These have been identified by chromatography. This may be the reason for rapid froth production with legumes as this phenomenon is absent or less extensive in grasses. This work may be an important contribution to the bloat problem. In studies on the effect of protein level of forage on incidence of bloat, the disease could be produced in a severe nature by the addition of egg albumen to ground alfalfa. The rate of eructation was normal or slightly accelerated but the amount of gas eructed per belch did not suffice to prevent bloat.

(d) Feedlot Bloat and Bacteriological Studies

A diet has been developed that will result in frothy bloat in cattle. A difference has been noted among animals in their susceptibility to bloat. The incidence of and severity of bloat in relation to the time the animals received the bloat producing diets was increased materially. This increase in the incidence of bloat with time can not be correlated with any of the existing theories for the pathogenesis of bloat. It has been found, however, that certain changes in the nature of the

ruminal contents is correlated with the incidence of this type of bloat. A highly significant correlation between the percentage of encapsulation of microorganisms and the occurrence of bloat was noted. Over a 16 week period during which the incidence of bloat steadily increased, negative correlation was found between the percent of ruminal contents which settled out into a liquid phase and the incidence of bloat. Bacteriological and biochemical studies conducted during this period indicated that the metabolic activity of the rumen microorganisms did not reach an equilibrium for a considerable length of time after the cattle were started on the bloat producing diet. This finding is significant in that it is generally believed that the metabolic activity of rumen microorganisms reaches an equilibrium very rapidly following a dietary change.

An in-vitro test for studying the stability of froth of ruminal contents indicated that methyl-silicone preparations are effective in breaking froth, but that they may have to be used in larger quantities than often recommended. Turpentine and kerosene are very effective in breaking frothy ingesta in in-vitro tests. A number of detergents proved to be ineffective in reducing the formation of froth.

(e) Chemical Composition of Legumes in Relation to Bloat

The readily fermentable sugars of legumes may result in rapid gas formation and thus contribute to the pathogenesis of acute bloat. In studies on the carbohydrate content of alfalfa and Ladino clover forage it was found that the total sugar content of Ladino clover may be as high as 10 to 12 percent (dry matter basis) during the bloating stages of growth. The total soluble sugars vary according to the season of the year and with the time of day. The total soluble sugars content can also be affected by fertilizer application.

Plans

Work on all phases of ruminant bloat will be continued and expanded to learn more of the normal and contrast them with bloated cows. (See Proposals for Committee Consideration).

Publications

Studies on Biochemical, Physical, and Bacteriological Factors Involved in Feed Lot Bloat. Don R. Jacobson and Ivan L. Lindahl. Uni. of Maryland Misc. Pub. 238, June 1955.

Physical Properties of Paunch Juice Which May Contribute to Bloating. R. E. Nichols. Veterinary Medicine 51, No. 2, pp. 47-52, February 1956.

The Effect of Protein Level on Rumen Volatile Fatty Acids. N. S. Woodhouse, R. F. Davis, and G. H. Beck. Misc. Pub. No. 238, Maryland Agr. Expt. Sta., June 1955.

Publications (continued)

Physiological Effects of Insufflation of the Stomach. R. W. Dougherty, D. C. Meredith and R. B. Barrett. Amer. Jour. Vet. Research, Vol. 16, 1955.

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Cinefluorographic Studies of the Ruminant Stomach and of Eructation. R. W. Dougherty and C. D. Meredith. Amer. Jour. Vet. Research, Vol. 16, 1955.

A Sampling Tube for Rumen Fluid. R. E. Nichols. Amer. Jour. Vet. Research, July 1955.

Physiological Studies of the Vagal Nerve Supply to the Bovine Stomach. II. Studies on the Eructation Mechanism in Adult Cattle. H. E. Dziuk and A. F. Sellers. Amer. Jour. Vet. Research, Vol. 16, No. 61, pp. 499-504, Oct. 1955.

Physical Properties of Paunch Juice Which May Contribute to Bloating. R. E. Nichols. Vet. Med., Vol. 51, No. 2, pp. 47-52, Feb. 1956.

The Apparent Surface Tension and Relative Viscosity of Paunch Fluid of Cattle Fed Hay, Fresh Grass, or Fresh Legumes. R. E. Nichols, R. D. Dillon, Katherine Penn, Jean Bryant, and John Schreiber. Vet. Med., Vol. 51, pp. 389-391, Aug. 1956.

The Sequence of Events Preceding Death of a Cow in Acute Experimental Bloat on Fresh Alfalfa Tops. J. M. Boda, P. T. Cupps, Harry Colvin, Jr., and H. H. Cole. Jour. Amer. Vet. Med. Assn., Vol. 128, No. 11, pp. 532-535, June 1, 1956.

11. Stomach Worms Injurious to Cattle in the South

ARS-ADP

Experiments carried out at Auburn, Alabama, showed that the medium stomach worm and the stomach hairworm are among the most injurious of the various kinds of worm parasites that attack calves in the Southeast. These worms either killed the test calves, or injured their health so seriously as to cause marked loss of weight, or retardation in growth. The experiments showed, moreover, that the intestinal hairworm was at least as injurious to the test calves as these stomach worms.

Plans

Studies are being continued to evaluate the effect of parasites in the growth of calves, and determine which of the various ones are the most injurious.

12. Stomach Hairworms from Horses Injurious to Calves

ARS-ADP

Three-month-old dairy calves (coop. Ky. Agr. Expt. Sta.) succumbed to heavy infections with the strain of the stomach hairworm that occurs in horses. The parasites caused severe inflammation of the fourth stomach and produced significant changes in the composition of the blood serum. These changes included a decline in the total amount of serum protein and the albumin component and an increase in one of the serum globulins. The finding that the stomach hairworm is transmissible from horses to calves and can be injurious to them points up the danger of grazing calves on pastures occupied, or recently occupied, by horses. It indicates the need for more investigation of the susceptibility of various classes of livestock to parasites that are common to more than one class and the impact of cross-transmission from one host to another on the economy of production of the respective classes.

13. Summer-Rested Pastures Safe for Grazing in Late Fall

ARS-ADP

At Beltsville, permanent pastures of native grasses, known to be heavily contaminated with parasites during the summer, were made relatively safe for cattle by withholding infected animals from them during the period August through October. During the 3-month resting period, most of the parasite larvae on the pasture died off, in the absence of cattle hosts, and beginning early in November animals were safely maintained thereon. Even though such a pasture was again contaminated in the fall, infective larvae did not develop or survive in sufficient numbers during the winter months to make the pasture dangerous to cattle grazed during the following spring. Other studies are being carried out to provide information on methods of circumventing clinical parasitism by pasture management.

14. Parasites Increase Cost of Cattle Production

ARS-ADP

Losses from roundworm parasites, estimated at about \$1,500 per farm were sustained by cattle raisers on 13 farms in Georgia where losses from parasites have been a serious drain on cattle production. Losses from sickness and death of parasite affected animals ranged from \$56 to nearly \$3,200 per farm. The affected animals harbored an average of more than 100,000 worms per head, whereas non-affected animals in the same general area had less than 5000 per head. Seventeen different kinds of roundworms were involved, two of which have not been previously found in the south.

Plans

Investigations to determine the extent of the production losses that parasitism of livestock causes in the South, and to identify the conditions on farms, including husbandry practices, that need to be corrected to prevent these losses are being continued.

15. Pasture Types Influence Consumption of Phenothiazine by Grazing Cattle

ARS-ADP

Yearling cattle grazed during winter and spring on crimson clover cheat grass and on oats pastures (coop. Ga. Agr. Expt. Sta.) and periodically dosed with phenothiazine, consumed enough of this drug by licking medicated mineral blocks to affect fairly adequate control of adult stomach worms. These parasites are among the most injurious, if not the most harmful, of the worm parasites that affect calves in the South. Similar cattle pastured on ryegrass did not take in enough of the drug to control satisfactorily the parasites, except when the grazing was poor, when more of the drug was consumed with beneficial results.

In another test, yearlings grazing on fescue and on ryegrass consumed enough of the drug to reduce development of infective roundworm larvae on the pastures, whereas those grazing on temporary forage did not take in enough of the drug to cut down the pasture's infectiousness materially.

Plans

The work is being continued to obtain facts on which to build a successful means of controlling roundworm parasites by free-choice consumption of drugs by cattle on pasture.

16. Young Cattle Need Protection Against Worm Parasites

ARS-ADP

In tests at Beltsville, cattle 9 to 18 months old, reared parasite free, were highly susceptible to the injurious effects of common species of roundworms of the digestive tract. When heavily exposed to infection the younger animals suffered from diarrhea, which was bloody in some cases, failed to eat normally, lost weight, became prostrated and died. Some died so soon after infection that examination prior to death would not have proven that they were suffering from parasitism. The older animals, less heavily exposed to infection, all survived but some scoured and all either lost weight or failed to gain weight normally.

Plans

The observations are being continued.

17. Bulls Susceptible to Trichomonad Parasites of Swine

ARS-ADP

A bull (coop. Utah Agr. Expt. Sta.) that bred cows harboring in the reproductive tract an infection of trichomonad parasites from the gut of swine, became infected with these parasites, and subsequently transmitted them to other heifers. Previous work has shown that trichomonad parasites of porcine origin can parasitize the reproductive

tract of cows and cause breeding difficulties. There is a rather widespread farm practice of associating swine and cattle, particularly dairy cattle. These findings indicate that porcine trichomonads may constitute another problem in connection with breeding difficulties in cattle.

Plans

The work is continuing.

18. Calves Susceptible to a Blood Parasite of Humans

ARS-ADP

Work at Beltsville showed that dairy calves can harbor a flagellated blood parasite (trypanosome) that causes a severe and often fatal disease of humans (Chagas' disease) in Central and South America. This disease has recently been diagnosed in two persons in Texas. The parasites were discovered in a raccoon in the vicinity of Beltsville. It has been known for a long time that wild animals of the Southwest are infected but this is the first time these parasites have been found this far north. They are transmitted by insects (kissing bugs) that feed on animals and humans. Some of these insects are more or less common in the Beltsville area. Although the calves that were inoculated with the parasites have shown no recognizable symptoms, the organisms could be found in the blood stream for several days, after which they were found for longer periods in the heart and elsewhere in the body of animals autopsied, and presumably could serve as sources of infection of bugs that might feed on them.

Plans

The investigations are being continued.

19. Winter Scours of Calves

ARS-ADP

Studies (coop. Mont. Agr. Expt. Sta.) of factors governing the spread of winter scours (coccidiosis) of calves showed that when the infective stage (oocyst) of the parasite became fully developed they enter a dormant stage and are highly resistant to climatic conditions. This enables them to survive in the environment of calves and develop when swallowed by them. After the oocysts have begun to develop unfavorable weather may retard, but not stop, development. The high degree of resistance to unfavorable conditions, which the fully developed infective stages attain complicates the problem of control.

In a small test carried out under experimental conditions to devise means of combatting winter scours, dairy calves that recovered from a severe initial infection of the parasites were somewhat resistant to the effects of another. Calves so infected failed to develop the syndrome of bloody scours characteristic of this disorder, but their growth was retarded.

Plans

Work is continuing to obtain facts relative to parasitic winter scours that can be used as a means of combatting this condition.

20. Treatments for Reproductive Failures Due to Parasites

ARS-ADP-

Progress is being made in the search for treatments that will check abortions and other reproductive failures (genital trichomoniasis) (coop. Utah Agr. Expt. Sta.) by destroying trichomonad parasites in the reproductive tract of bulls. Once a bull becomes infected with these parasites he infects the cows he breeds. No entirely satisfactory means of curing infected bulls is available. Promising results have been obtained by massaging the reproductive organs with an ointment containing acriflavine, but the treatment is difficult to apply satisfactorily, and the most effective strength of the ointment has not been determined. Ointments strong enough to insure destruction of the parasites have injured severely the reproductive organs of some bulls. Those not strong enough to cause injury, eliminated the parasites in some cases, and failed in others. Ointments of intermediate strengths were tried. The least harmful and most effective one contained 0.35 percent acriflavine. Several bulls so treated were freed of the parasites as determined by laboratory examinations and breeding trials with susceptible heifers.

Because of the difficulties connected with the use of medicated ointments, emphasis is being placed on the search for drugs that can be used for washing out the reproductive tract without injury to delicate tissues, and at the same time destroy the trichomonad parasites. Hamsters have been used in this phase of the investigation, and a wide variety of drugs was used. Only one, a new product known as furazolidone, gave promising results. About 2/3 of a series of hamsters were cured of trichomonads by washing out the reproductive tract with the drug, without visible injury to the tissues. Although furazolidone has not been tried on cattle, the results with hamsters indicate that it may provide an easily administered and effective treatment against genital trichomoniasis.

Plans

This work is being continued.

21. Phenothiazine Aids in Lungworm Control

ARS-ADP

Limited trials with dairy calves indicated that phenothiazine may be of value in controlling cattle lungworms by reducing the number of the infective stage of these parasites in the droppings of infected animals after treatment. This would serve to reduce pasture contamination. Infected calves dosed with a small amount of phenothiazine daily, stopped passing larvae in the feces on the ninth day. Although

the drug was given by mouth, enough of it was apparently carried to the lungs, either to kill the lungworms or stop their reproductive activities. A single dose of phenothiazine was less effective as it temporarily reduced, but did not eliminate entirely, the number of larvae in droppings.

Sodium iodide, a chemical that had shown some activity against lungworms was tried. Two injections of a mild solution of the chemical into the veins of lungworm-infected calves reduced temporarily the number of lungworm larvae in the droppings, but the reduction was not permanent. Lungworms are important parasites of cattle grazing on irrigated or low-lying, moist pastures. There are at present no entirely effective treatments for these parasites. The finding that phenothiazine has an effect on roundworms in the lungs may prove valuable.

Plans

This work is being continued to develop an effective means of checking losses due to lungworms by means of curative or preventive treatments.

22. Cattle Scabies in Rabbits

ARS-ADP

In studies to discover sources of hitherto unexplained outbreaks of common scabies of cattle, it was found that the mites can live on domestic rabbits for varying periods of time. This finding is of importance in relation to the problem of controlling scabies in cattle. Spontaneous outbreaks of scabies occur from time to time in herds into which no new animals have been introduced. This indicates that reservoir hosts of the mites other than cattle may be responsible for the outbreaks.

Plans

The work at Albuquerque, New Mexico, is being continued to determine the length of time rabbits can harbor the mites, whether these parasites can be established in cattle after having spent some time on the rabbit host, and whether natural infections of the parasites occur on wild rabbits and animals of a similar nature that frequent premises where cattle are kept.

23. Good Forage Aids in Parasite Control

ARS-ADP

Studies (coop. Ga. Agr. Expt. Sta.) indicated that forage quality may be an important factor in the control of roundworm parasites of grazing calves by the use of a phenothiazine-mineral mixture. Calves that grazed on fescue and on winter ryegrass pastures consumed more of the ^{medicated} mineral mixture and apparently contaminated the pastures with parasites to a lesser extent than was the case with calves grazing

temporary winter oats pastures. The extent of pasture contamination was determined by counts of the numbers of parasite larvae recovered from weighed amounts of forage collected from the pastures. The most larvae were recovered from pastures grazed by untreated calves, the fewest from fescue pastures grazed by treated animals, and intermediate numbers from temporary oats pastures, also grazed by treated calves.

Plans

Work is continuing to improve existing methods of controlling parasitism in calves by preventive treatments in relation to grazing practices.

24. Screw-Worm

ARS-ENT

Excellent progress has been made toward attainment of improved methods of rearing, sterilizing, and releasing screw-worm flies for possible eradication of this pest in the Southeast. Beef heart, which costs only one-third as much as lean beef, is an excellent larval rearing medium and is readily obtainable in the quantities required to produce millions of flies per week. Progress was also made in developing more uniform and efficient methods of rearing and handling large numbers of screw-worms, further reducing costs. Effective methods of minimizing decomposition and of removing undesirable odors and decomposition products in large rearing plants were developed. As a result of progress it was possible to prepare preliminary specifications for the construction of a rearing and handling plant and to make estimates of the probable cost of an eradication program. Progress was also made in the development of a strain of fly that produced more eggs, mated more frequently and lived longer than wild strains for use in an eradication program. A number of highly attractive materials for use in determining natural population densities and for incorporation in poison baits were developed, but none have proven satisfactory for the purposes desired. Efforts are continuing to develop more effective attractants and methods of distribution and to determine the most effective distribution pattern for eradication.

Laboratory screening tests revealed a number of new chemicals which were effective substitutes for lindane in smears for the control of screw-worms in wounds. Several of the new insecticides were equal to lindane in speed of kill and provided longer protection from reinfection. The most promising materials were Dow ET-15 and Dow ET-57. Dow ET-57, which has proved so outstanding against cattle grubs, is also effective against screw-worms when administered orally to livestock. More effective insecticides and other methods of control are necessary to combat the screw-worm in the Southwest and West, where eradication is not feasible.

Plans

Work will be continued to perfect mass rearing techniques and the development of attractants. Field trials will be initiated to determine the best swath widths of release from airplanes and intervals of release.

Publications

Screw-Worms That Attack Livestock. G. W. Eddy and R. C. Bushland, Yearbook of Agriculture, pp. 172-175, 1956.

Eradication of the Screw-Worm Fly by Releasing Gamma-Ray-Sterilized Males Among the Natural Population. R. C. Bushland, E. F. Knipling, and A. W. Lindquist. Proc. Intern. Conf. Peaceful Uses of Atomic Energy, 12: 215-220, May 1956.

Research on the Use of Systemic Insecticides for the Control of Livestock Pests. W. S. McGregor and R. C. Bushland. Jour. Econ. Ent. 49(1): 86-88, 1956.

25. Cattle Grub

ARS-ENT
& ADP

An organic phosphorus compound, Dow ET-57, appears to have exceptional promise in the control of cattle grubs. ET-57 is the first systemic insecticide that is effective in killing young grubs within animals. Tests in Texas and Oregon demonstrated that the material is effective against both species of cattle grubs. Oral dosages of 100 mg./kg. of the chemical two to three months before grubs normally appear reduced the number of grubs by more than 90 percent. This dosage requires approximately an ounce of insecticide for a 600-pound animal. Toxicological investigations have shown that ET-57 is not harmful to cattle at a dosage of 100 to 150 mg./kg., but a dosage of 200 mg./kg. produces toxic effects and 400 mg./kg. causes severe poisoning.

The insecticide can be administered safely and effectively on an estimated weight basis. It appears that a dosage of 100 mg./kg. provides about a 30 percent safety margin and may prove to be practical and safe. It has been found (coop. Ore. and Tex. Agr. Expt. Stas. and HN) that meat from treated animals slaughtered ten days after treatment has no off-flavor due to the insecticide. Working with radioactive ET-57 it has been found that the insecticide stores in fat but is rapidly eliminated. It appears doubtful that this compound can be used in cows where the milk is marketed unless the milk is withheld from human use for a period of time. However, calves, heifers, and dry cows can probably be treated without endangering milk.

Approximately 300 chemicals have been tested in the screening program using guinea pigs as test animals to find systemic insecticides for control of cattle grubs and other insects. A few promising leads have developed, the most important of which is that some externally applied materials may act as systemic insecticides. Preliminary tests indicate that Bayer 21/199 applied externally has systemic action on grubs.

Effort has been made to learn more about the biology of cattle grubs so as to make better use of control measures. Examinations of cattle gullets in Oregon showed young grubs reached a peak during October-December, declined rapidly during January and February, and were absent from March to June. They reappeared again in late July. Cooperative studies have been initiated with Canadian entomologists who had made great progress in obtaining eggs in the laboratory from heel flies. It now appears possible to obtain eggs and artificially infest cattle, thus removing the uncertainty of whether or not an animal used in experimental work is infested.

Plans

Research will be continued to determine the most effective and safest dosages of ET-57 over a wide geographical area. Screening of chemicals to find materials that will act systemically when applied as external sprays will be intensified.

Publications

Cattle Grubs. I. H. Roberts and A. W. Lindquist. Yearbook of Agriculture, pp. 300-306, 1956.

A Promising Systemic Insecticide for Control of Cattle Grubs. A. W. Lindquist. 35th Ann. Conf. N.C. Central States Entomologists, Vol. 11, pp. 3-4, 1956.

Toxicology of Insecticides. R. D. Radeleff, T. G. Woodard, H. V. Claborn, and R. C. Bushland. Yearbook of Agriculture, pp. 131-142, 1956.

Research on the Use of Systemic Insecticides for the Control of Livestock Pests. W. S. McGregor and R. C. Bushland. Jour. Econ. Ent. 49(1): 86-88, 1956.

26. Insecticide Residues

ARS-ENT
ADP & DH

It is important to determine the extent to which insecticides store in milk and meat when used on animals to control destructive insects or on forage which is fed to livestock. This research is conducted at Kerrville, Texas (coop. Texas and Okla. Agr. Expt. Stas. and ADP, industrial concerns, and livestock growers) and at Beltsville (coop DH).

Since methoxychlor is recommended for control of horn flies on cattle, it is advisable to obtain more information on its excretion in milk. Two dairy herds were sprayed with 2 quarts of 0.5 percent methoxychlor per animal. Composite milk samples from each herd showed a maximum residue averaging 0.17 p.p.m. one day after treatment. At 2 days, it was 0.13 and 3 days, 0.11 p.p.m. Samples taken 1, 2 and 3 weeks after spraying showed only trace amounts in the milk.

Toxaphene applied to cattle provides excellent control of ticks, lice, and other pest. Toxaphene was found to be excreted in the milk after spraying individual dairy cows with 0.5 percent suspensions and wet-table powders. The amounts varied from 0.47 to 0.92 p.p.m. during the first and second day after spraying. At 14 days the residues had decreased to an average of about 0.10 p.p.m.

Toxaphene is also a useful insecticide for the control of several injurious insects on forage crops. When toxaphene-treated feed was fed daily to dairy cows at dosages of 20, 60, 100, and 140 p.p.m. for an 8-week period, the insecticide was excreted in the milk at all dosage levels and at a rate of roughly 1 percent of the dosage given. The maximum excretion at the two lower dosages occurred at the end of the first and second weeks' feeding. The secretion of the insecticide average from 0.20 to 0.37 p.p.m. during the 8-week feeding period. One and two weeks after feeding ceased, the residue averaged 0.07 and 0.02 p.p.m. at the 20 p.p.m. feeding level.

Plans

Work will be continued to study the storage of new insecticides in meat, milk, and forage.

Publications

Insecticide Residues in Meat and Milk. H. V. Claborn. USDA, ARS-33-25, 30 pp., July 1956.

27. Toxicological Effects of Insecticides, Herbicides, and Fungicides for Cattle ARS-ADP

The effects on the health of cattle of various insecticides being used and of those showing promise are being studied to develop full information on the symptoms, lesions, largest safe doses, and smallest toxic doses. These include those being used externally on cattle, internally in cattle as systemic insecticides, and those used on forage. The work is being done in Kerrville, Texas (coop. ENT). 265 abdominal surgical operations were performed on cattle, sheep, and goats to obtain fat from the omentum required for tissue residue studies in connection with Public Law 517. Special attention was given to the toxicity studies on a new, promising systemic insecticide, Low ET-57, which is being used experimentally to kill grubs in cattle, and other

parasites. Toxicity studies on this compound were also extended to several hundred cattle treated with it on cooperating ranches where no symptoms of poisoning were noted. Subacute oral toxicity studies included the feeding of toxaphene to dairy cattle at 20, 60, 100, and 140 parts per million in the total diet for 8 weeks. No toxic effects were noted despite the fact that the 140 p.p.m. level provided approximately one-fourth the minimum toxic daily dose. It was found that relatively high dosages of atropine are required and frequent repetition may be needed to counteract poisoning of cattle by organic phosphorus compounds.

The toxicology studies were expanded during the year to include some work on herbicides. The toxicology of pentachlorophenol was determined and by this work it was shown that this method of defoliation of cotton did not cause the cottonseed cake and meal to become poisonous for cattle. Toxicology studies on a new compound known as delrad for the control of algae in ponds, lakes, and tanks were determined. It was found that delrad was safe when used according to recommendations.

Plans

Toxicology studies will be continued to obtain information on insecticides now used and on new promising ones. Surgical operations will be performed on cattle to collect abdominal fat for insecticide residue chemical tests.

Publications

The Past, Present, and Future of Systemic Parasiticides. R. D. Radeleff and George T. Woodard. Vet. Med., Vol. 51, No. 4, pp. 152-154, April 1956.

Hazards to Livestock of Insecticides Used in Mosquito Control. Mosquito News, Vol. 16, No. 2, pp. 79-80, June 1956.

The Acute Toxicity of Chlorinated Hydrocarbon and Organic Phosphorus Insecticides to Livestock. R. D. Radeleff, G. T. Woodard, W. J. Nickerson, and R. C. Bushland. USDA Tech. Bul. 1122, Nov. 1955.

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Toxicity of Insecticides. R. D. Radeleff, G. T. Woodard, and R. C. Bushland, USDA Yearbook of Agriculture, pp. 131-142, 1956.

Pesticide Residues in Animal Products. Roscoe H. Carter, H. V. Claborn, G. T. Woodard, and Ray E. Ely. USDA Yearbook of Agriculture, pp. 143-148, 1956.

Publications (continued)

Toxicological Problems in the Use of Systemic Insecticides for Livestock. R. D. Radeleff and R. C. Bushland. Jour. Econ. Ent., Vol. 49, No. 1, pp. 89-91, Feb. 1956.

28. Horse Flies and Deer Flies

ARS-ENT

Research has continued on the biology of several species of horse flies and deer flies in Fla., Miss., Okla., and Ore. Information has been obtained on breeding places, adult flight and resting habits, and length of larval life. Most species exist as larvae for several months to over a year. In Miss. it was found that the larvae of some species of horse flies which normally live in a moist soil environment can exist for extended periods when the soil becomes dry due to drought conditions. Work will be completed soon on a technical bulletin which draws together all the biological information obtained.

Plans

Research will be directed toward use of attractants and other means of control in addition to the development of better livestock protectant sprays.

Publications

Flies That Affect Livestock. E. F. Knipling and W. C. McDuffie. Yearbook of Agriculture, pp. 166-172, 1956.

How Diseases and Parasites are Spread. H. W. Schoening, B. Schwartz, and A. W. Lindquist. Yearbook of Agriculture, pp. 40-45, 1956.

29. Ticks and Lice

ARS-ENT
& ADP

In the systemic screening program, four compounds have shown activity against ticks and will be further evaluated. Dow ET-57, effective against cattle grubs, did not show promise when given to cattle infested with ticks but was effective in ridding cattle of lice when administered at the rate of 100 mg./kg. of body weight. Louse eggs present at time of treatment are not destroyed and animals can therefore become reinfested in about two weeks. A heavy infestation of the foot louse of sheep was not controlled by a 0.5 percent toxaphene spray, but a later treatment in a wading vat eradicated the infestation. Malathion applied to a large number of goats and sheep after shearing freed them from lice, but it is not certain that this insecticide provides as long-term protection as DDT and similar materials.

Plans

Research will be intensified to find and develop systemic insecticides for control of ticks and lice.

Publications

Cattle Lice. C. L. Smith and I. H. Roberts. Yearbook of Agriculture, pp. 307-309, 1956.

Research on the Use of Systemic Insecticides for the Control of Livestock Pests. W. S. McGregor and R. C. Bushland. Jour. Econ. Ent. 49(1): 86-88, 1956.

30. Mosquitoes

ARS-ENT

Tests were conducted (coop. Ark., Ore., and Calif. Agr. Expt. Stas.) to perfect methods of applying insecticides to irrigation water to control mosquito breeding in pastures and fields. Excellent larval control was obtained with parathion at only 0.02 p.p.m., with Bayer L 13/59 at 0.5 p.p.m., and with Bayer 21/199 at 0.2 p.p.m. The distance from the point of application that the insecticides were effective ranged from one-fourth to five-eighths of a mile, but better formulations apparently will be required to insure control for greater distances. Research in Fla. and Calif., where mosquitoes are highly resistant to DDT and other chlorinated hydrocarbon insecticides, indicates that control of both adults and larvae can be obtained with 0.25 to 0.5 pound per acre of malathion, Chlorthion, and Bayer L 13/59. Bayer 21/199 was also highly effective as a larvicide at 0.25 pound per acre. Progress was made in the development of effective granular insecticides for larvicing due chiefly to studies which provided a better understanding of the effect of diluents and concentration on the release of the insecticide in water.

Research has continued to find and develop insecticides which will protect livestock against mosquito attack, but nothing has been found that is more effective than pyrethrum preparations.

Plans

In view of increasing mosquito resistance to insecticides, research will be continued to develop substitute materials and new methods of control.

Publications

Notes on Mosquito Resistance to DDT in California. C. M. Gjullin. Proc. & Pps. 24th Ann. Conf. Calif. Mosq. Cont. Assn., pp. 61-62, Jan. 1956.

Publications (continued)

Control of Mosquitoes Under Irrigation and Floodwater Conditions. A. W. Lindquist. Proc. & Pps. 24th Ann. Conf. Calif. Mosq. Cont. Assn., pp. 9-11, Jan. 1956.

Field Tests with Two Phosphorothioates Against Salt-Marsh Mosquitoes. J. B. Gahan, J. H. Bertholf, A. N. Davis, Jr., and Carroll N. Smith. Mosq. News 16(2): 91-93, 1956.

Mosquitoes on Livestock and Man. A. W. Lindquist and W. C. McDuffie. Yearbook of Agriculture, pp. 177-180, 1956.

31. Horn Flies and Stable Flies

ARS-ENT

Research was continued to find new insecticides for the control of horn flies and stable flies which will not result in undesirable residues in meat and milk. Screening and evaluation of hundreds of compounds failed to produce any promising new sprays. Studies showed that malathion does not create residues in meat and secretes only briefly and in minute amounts in the milk, but it provides control of horn flies for only 5 to 10 days as compared to 3 weeks or more for methoxychlor and DDT.

The search for new insecticides and other methods for protecting cattle against stable flies has been expanded to include attractants with the hope of finding a material that could be utilized in poison baits, but none were promising. Blood seemed to have some attractancy in laboratory tests, and 29 pure amino acids of blood were isolated and tested. Seven showed some attractancy but not as much as whole blood or blood solids. Work has started (coop. Neb. Agr. Expt. Sta.) to study habits of stable flies in relation to developing control methods of larvae, of adults at their resting places, and as sprays on livestock. Preliminary work indicates that residual spraying of barns, the exterior of feed troughs, silos, and fences on farm lots with Diazinon provides control for only a few days.

Plans

Research will be continued to develop long lasting sprays and to study habits of the insects in relation to control methods.

Publications

Control of Livestock Insects in Pastures. A. W. Lindquist. Proc. Ann. Meet. Joint Comm. Grassland Farm. in Coop. with ESA, Nov. 30, 1955.

Insects as Livestock Pests. A. W. Lindquist. Soap and Chem. Spec. 32(4): 146-148, 165, 1956.

Flies that Affect Livestock. E. F. Knipling and W. C. McDuffie. Yearbook of Agriculture, pp. 166-172, 1956.

32. House Flies

ARS-ENT

Studies were continued to develop new baits and methods of utilizing them for the control of flies under a variety of conditions in Fla., Neb., and Calif. In Fla. granular baits containing organic phosphorus insecticides broadcast on floors of barns continued to give excellent control of flies. Similar applications were less effective in Calif., presumably because a large part of the fly population tends to congregate on the ceilings and walls. Under such conditions excellent control was obtained with syrup baits painted on portions of walls and stanchions or applied to cloth strips festooned from ceilings. In Neb. good control was obtained with all types of baits, but daily applications over a period of two weeks were necessary to maintain control. In Fla. and Neb. residual applications of 50 to 100 mg./sq. ft. of Diazinon provided excellent control of flies for two to three weeks in all cases and for as long as five weeks in several locations. In tests in Fla. and Calif. excellent control of fly larvae was obtained for one to two weeks by spraying manure with 25 to 100 mg./sq. ft. of Diazinon. Malathion, Chlorthion, Dow ET-57, and several other organic phosphorus insecticides were effective initially but even heavy applications permitted larval breeding to resume within a few days. Preliminary tests showed that fly breeding could be minimized by applying highly absorptive diluents such as gypsum and diatomaceous earth to reduce the moisture content of manure below that required for larval survival. Research demonstrated that flies could be controlled under the worst possible conditions through judicious use of the bait principle and the application of fly larvicides to breeding areas.

Plans

Research is to be continued on finding and development of superior insecticides and methods of applying them.

Publications

Fly Control for Cities. Carroll N. Smith and J. C. Keller. Public Works, p. 122, June 1956.

33. Insects on Pasture and Hay Crops

ARS-ENT

Studies were continued on control of insects attacking pasture and hay crops. The spotted alfalfa aphid has now spread into 25 States. Three species of parasites of this insect (coop. Calif. Agr. Expt. Sta.) have been introduced and released in 9 States. Recoveries have been made in four States, but it is too early to determine if the parasites have become permanently established. Lahontan alfalfa continues to be highly resistant to the spotted alfalfa aphid and selections from Ranger and African have considerable resistance.

Studies in Maryland showed that mixtures containing heptachlor and demeton, heptachlor and malathion, heptachlor and Diazinon, dieldrin and malathion, and aldrin and malathion gave satisfactory initial control of both the alfalfa weevil and pea aphid on alfalfa. None of these combinations of insecticides were effective against the pea aphid four weeks after application, and only the dieldrin-malathion mixture controlled the alfalfa weevil for that length of time.

Plans

Studies on the control of injurious legume and grass insects will be continued.

Publications

Residues on Forage, in the Soil and in Milk Following Pasture Treatment with Granulated Dieldrin. B. A. App, R. H. Carter, and R. E. Ely. Jour. Econ. Ent. 49(1): 136-137, 1956.

Legume and Grass Insect Investigations. E. W. Beck. Ag-Research Briefs, Ga. Agr. Expt. Stas. 2(1): 3, 1956.

The Alfalfa Weevil - How to Control It. USDA Leaflet No. 368, 1956

F. HOUSING AND EQUIPMENT

1. Reducing Chore Time and Labor on Dairy Farms

ARS-AE

The cost of labor continues to be a big factor in dairy operations. Although the habits of the dairyman influence to a great extent his work methods and thus his time and labor requirements, such factors as arrangement of work areas and location of equipment, sanitation practices and design of buildings all have a bearing on whether or not unnecessary time and labor are used. Both time and steps may be saved by providing only as much space per cow as is actually needed. In the moderate climates where studies have been made, 45 to 50 sq. ft. per cow is ample in resting area; 25 sq. ft. per cow in feeding area. Adult animals require about 30 inches of manger space. Labor and time may be saved by letting the cow carry her own feed. Twenty feet of feeding space is sufficient for 30 to 35 cows in self-feeding silos. Some milk shed regulations require unnecessary labor and time. A small electric motor will do more work continuously than a man can do at short intervals--pump milk from cows to tank and from tank to truck.

Studies are now being organized or getting under way in Minn. and Wash. where the work includes the design and development of equipment with special emphasis on electric power to replace hand power.

2. Effect of Temperature on Growth of Calves

ARS-AE

Beef type calves were subjected to test in the Psychrometric Laboratory (coop. Mo. Agr. Expt. Sta.). Beef type calves were used because it was believed that beef and dairy type calves would react in the same way to a given environment. Shorthorn, Brahman and Santa Gertrudis calves of approximately the same ages and weights were selected--all from Texas. Three of each breed were kept in chambers at 50° F and 80° F. Brahman cattle gained a little faster in the 80° chamber than in the 50°. Shorthorns did best at 50°. Santa Gertrudis did about equally well in both.

After being subjected to these conditions for a year the calves were kept at higher temperatures. No appreciable amount of acclimatization had taken place. Shorthorn calves grown in the 50° chamber stood a 110° temperature better than Shorthorns grown in the 80° chamber. Tests at 105° F with different wet bulb temperatures showed that at high temperatures relative humidities make significant difference in rate of growth.

In tests on beef type animals at the Imperial Station, Calif., it was noted that providing them with shades, cooled drinking water, surrounding the corrals with green vegetation, wire fences, and blowing air over them each apparently resulted in increased rates of gain but providing all of these things at once did not result in gains equal to the sum of the gains that were obtained when each was provided separately.

Publications

Interrelations Between Temperatures of Rumen (at Various Depths), Rectum, Blood, and Environmental Air; and the Effects of an Antipyretic, Feed and Water Consumption. S. Brody, H. E. Dale and R. E. Stewart. Mo. Agr. Expt. Sta. Res. Bul., No. 593.

Heat and Moisture Removed by a Dairy Stable Ventilation System During Diurnal Temperature Rhythms. R. G. Yeck. Mo. Agr. Expt. Sta. Bul. No. 595.

Moisture Vaporization by Jersey and Holstein Cows During Diurnal Temperature Cycles as Measured with a Hygrometric Tent. R. G. Yeck and H. H. Kibler. Mo. Agr. Expt. Sta. Res. Bul. 600.

Influence of Diurnal Temperature Cycles on Heat Production and Cardio-respiratory Activities in Holstein and Jersey Cows. H. H. Kibler and S. Brody. Mo. Agr. Expt. Sta. Res. Bul. No. 601.

Bank Barns Compared with Above-Ground Barns for Housing Dairy Cattle. Max J. LaRock and R. G. Yeck. Production Res. Rpt. No. 2, USDA.

Publications (continued)

Use of I^{131} in the Study of the Influence of Climatic Factors on Thyroid Activity and Productivity of Livestock. C. Blincoe and S. Brody. International Conference on the Peaceful Uses of Atomic Energy, V. 12, pp. 266-271.

Gradients in Rumen, Blcnd, and Rectal Temperatures. S. Brody, R. E. Stewart and H. E. Dale. Jour. Dairy Sci., 14: 1243, Nov. 1955.

Rabbits as Substitutes for Cattle in the Study of Climatic Physiology. H. D. Johnson and S. Brody. Jour. Dairy Sci. 14:1247, Nov. 1955.

Relative Heat Tolerance of Santa Gertrudis, Brahman, and Shorthorn Heifers. H. H. Kibler and S. Brody. Jour. Dairy Sci. 14:1248, Nov. 1955.

Relative Growth Rates at 80° and 50° F of Santa Gertrudis, Brahman, and Shorthorn Heifers. E. B. O'Bannon, P. R. Cornelison, A. C. Ragsdale and S. Brody. Jour. Dairy Sci. 14: 1187, Nov. 1955.

Relative Energy Exchange and Body Temperature Regulation in Cattle and Man, 50° to 105° F. Ambient Temperature. S. Brody. Refrig. Engr. 63: 47-48, Dec. 1955.

Do Cow Barns Need Air Conditioning? S. Brody. Refrig. Engr. pp. 39-45, April 1956.

Effect of Environmental Temperature Rhythms on Blood and Serum Volumes and Body Water in Dairy Cattle. H. E. Dale, S. Brody, and Gloria J. Burge. Federation Proc. 15: 1, March 1956.

Reactions of New Zealand Giant Rabbits to Ambient Temperatures 9° - 40° . H. D. Johnson, C. S. Cheng, and Samuel Brody. Federation Proc. 15:1, March 1956.

Climatic Physiology of Cattle. Samuel Brody. Jour. Dairy Sci. 39:6, 715-725, June 1956.

Evaporative Cooling in Indian and European Evolved Cattle. R. G. Yeck and Samuel Brody. Jour. Dairy Sci. 39:7, p. 935, July 1956.

3. Silage Storage Research

ARS-AE

Silage storage and feeding work continued' (coop. DH, APH, SWC, and Ga. Agr. Expt. Sta.). Density apparently has the most direct relationship with pressures although type of material, moisture content and fineness of cut also affect pressures. Results to date indicate that horizontal pressures will vary from 125 to 150 pounds per sq. ft. in silos with 8 ft. walls. The higher pressures are associated with high density chopped silage. Pressures in well packed silos filled with orchard grass where silage density is high, fall off slowly after filling and packing ceases. In silos filled with low density silage

pressures may fall off as much as 50 percent during the first month of settling. Comparable vertical loads on the walls range from 50 to 100 pounds per sq. ft., and tend to increase from 25 to 50 percent during the first month after filling. Additional study will be required to determine the effect of type of material ensiled, moisture content and fineness of chopping on pressure for design purposes.

Results with covers to reduce top spoilage and leaching on bunker and stack silos indicate that covers must form a positive air and water seal to be effective and that care must be used to keep air from contacting the entire surface of silage when the silo is opened. Polyethylene and vinyl chloride plastic films prevented spoilage on small pilot sized stack silos. Neoprene coated nylon fabric covers on bunker silos reduced top spoilage and saved 5 pounds of silage dry matter per square foot of surface. This saving was made even though the bunker silos were re-covered with the plastic cover 30 days after the silos were filled. The cover of fiber reinforced paper and long hay during the first 30 days after filling had allowed molds to penetrate to a depth of 3 inches at different points on the surface.

Several test coatings have been applied to the inside surface of monolithic concrete and concrete stave silos in an attempt to find an effective cover that will stand up for 10 years or longer under farm conditions. Several coatings are effective after 2 years of use.

Progress is being made in an evaluation of horizontal silos in the South. Preliminary results indicate that silage of Rescue and Fescue grass exert less pressure and have a lower density than corn or orchard grass silage.

4. Equipment and Methods for Harvesting Forage Crops for Silage ARS-AE

Harvesting forage constitutes one of the major input costs in livestock production particularly on small farms. This work is directed to determining the relative efficiency and merits of various methods and equipment for harvesting grass silage in terms of rate of storage of dry matter, preservation of nutrients, and labor requirements (coop. DH and Regional Project NE 13).

Identical forage choppers equipped with different pick-up attachments were used to harvest both high-moisture and wilted silage from comparable measured field areas. Under comparable conditions the wilting method, using the combination mower-rake with a windrow pick-up chopper, gave consistently higher tonnages of dry matter per hour of operation.

The use of windrow pick-up equipment also gave consistently higher tonnages of dry matter per hour than direct-cut equipment in material of equal moisture content. The differential between methods increases with decreasing crop yields, making windrow equipment advantageous for second- and third-cutting operations. In crops varying from $3\frac{1}{2}$ to 4 tons per acre wet weight maximum harvesting rates with the wilting

method approached 4 tons of dry matter per hour, windrow pick-up exceeded 3 tons per hour, and direct-cut 2 tons per hour. Labor requirements for windrow pick-up operations are somewhat higher than for direct-cut, but the higher harvesting rate tends to compensate for this.

Plans

This work will continue, with emphasis on the development of basic principles for efficiently handling forage crops from the field to storage under the varying conditions encountered on farms.

5. Engineering Research on Bulk Milk Cooling Equipment

ARS-AE

A survey of engineering research underway or completed on the design, installation, and operation of farm bulk milk cooling equipment is being initiated (contract Iowa Agr. Expt. Sta.). Certain studies of energy use of 138 bulk milk coolers on Iowa farms and of electric demand of 10 units each of the direct-expansion and ice-bank type coolers were started previously. A report will be compiled based on results obtained in the survey from which a publication may be prepared and for use as a guide for additional research.

Investigations to determine the feasibility of applying the heat-pump principle to bulk milk coolers have been initiated (coop. Wash. Agr. Expt. Sta.). Heat extracted from the milk is normally dissipated to the air around the compressor or to cooling water which is usually wasted as far as the heat energy is concerned. Recovery of any of the heat extracted from the milk by equipment based on the heat-pump principle represents a potential saving to the dairy farmer. Such heat may be used to warm the milk house during cool weather or to preheat water used for washing dairy utensils. Initial development of necessary equipment is being made with a direct expansion type bulk milk cooler.

6. Electric Fences for Rotation Grazing

ARS-AE

The objective of this work is to develop dependable electric fence systems useable in rotation grazing. (coop. DH). Previous developments of improved insulators and portable posts by this project have resulted in commercial manufacture of some improved equipment. Improved insulators reduce surface leakage by a factor of ten in wet weather. Surface leakage of insulators shorts the shock voltage and results in loss of control of cattle. Labor for moving portable fences can be reduced by use of portable posts, quick-wire-attaching equipment, gate hooks and convenient layout of fences.

Plans

Continue the investigations to determine the electrical characteristics of effective electric shock in relation to energy limitations

required for safety. There is widespread use on farms of fence controllers which do not meet specifications of regulatory safety codes.

Publications

Efficiency Factors in Electric Fence Operation, L. E. Campbell, G. R. Mowry, and J. G. Hartsock. Agricultural Engineering, March 1956.

G. ECONOMICS OF PRODUCTION

1. Acreage Reduction

ARS-PE

A study of acreage reductions imposed on 1954 and 1955 crops requested by the 84th Congress has been completed and a report sent to the printer. It includes both an analysis of the aggregative effects of allotment programs and an appraisal of the effects of acreage allotments in different farming areas, based on personal interviews with nearly 3,000 farmers in 14 selected wheat, cotton, corn and rice areas.

In the areas studied, acreage allotments had had no significant effect on milk production through 1955. The acreage restrictions resulted primarily in a shift of some 25 million acres of land from allotment crops to nonallotment crops, mostly feed grains other than corn and oilseed crops. Relatively little acreage was diverted to pasture or hay production.

In the corn areas, intentional compliance with corn allotments was limited primarily to cash-grain farmers. Dairy farmers in northern Illinois had increased cow numbers slightly but they indicated that this would have occurred regardless of the acreage allotment program. In other areas, cow numbers were unchanged. Farm incomes of compliance farmers in the corn areas were lower than in 1953 but higher than they would have been had they stayed out of the program. Incomes in the cotton areas in 1955 exceeded those of 1953 because of higher yields, but they were 7 to 34 percent lower than they would have been had they been able to maintain both 1953 cotton acreages and 1955 price supports. Increased wheat yields more than offset reduced acreages in Kansas and North Dakota, but with normal yields the 1955 cropping pattern would have been less profitable than that of 1953 in all wheat areas studied.

2. Bulk Milk Handling

ARS-PE

Work is nearing completion on a farmers' bulletin on bulk milk handling to provide economic guides and interpretations needed by farmers in making sound decisions regarding the adoption and use of bulk tanks. Data have been assembled from secondary sources on investment required for equipment for various sizes of herds, labor savings to be anticipated with the adoption of bulk tank equipment, and the effect of bulk handling on quantity, quality, price and hauling charges of milk.

These secondary data were augmented by a number of case studies of typical dairy farms to illustrate the investments and costs incurred and the specific changes in operations which have accompanied adoption of bulk handling. These field studies have been made in N. H., Pa., Wis., S. Car., Ga., Ore., and Calif. Preliminary findings indicate that bulk handling of milk generally is liked by producers, not so much because it reduces costs as because it makes the milk handling job easier. Income-wise, bulk handling has different effects on different producers, depending largely on the size of herd and on the price premiums or reduced hauling charges accompanying this new technique. Some 30 cows or more appear to be required to offset the higher costs due to the rather heavy minimum investment required. Bulk handling provides both a means and an incentive to increase milk production. Many of the farmers interviewed had expanded operations after installing a bulk tank.

Publications

Milk Cows vs. Bulk Tanks. M. S. Parsons. Agr. Situation, Vol. 39, No. 10, p. 14, Oct. 1955.

3. Dairy Herd Replacements

ARS-PE

A study has been completed in New England of the economies incident to the raising or the purchasing of dairy herd replacements. It indicates that many of the suppositions held by the advocates of raising home-grown replacements are questionable. In a sample of several hundred DHIA cows comparable with respect to such factors as breed, date of freshening, management, fat content and age eliminated, purchased and raised cows produced about the same amount of milk. The difference in production was not significant when tested statistically.

Purchased cows were no more prone to disease than raised cows. Of herd removals, 43 percent of the purchased cows compared with 40 percent of the raised cows were removed for reasons of sterility, brucellosis or udder trouble. Farms with all raised cows removed 41 percent of their cows for reasons of udder trouble, sterility or brucellosis. Farms with some purchased animals lost only 37 percent of their cows due to these reasons.

Purchased cows had a longer productive life than raised cows. The average age at disposal for non-dairy purposes of purchased cows was 7.06 years, while that for raised cows was 5.74 years. The life expectancy of dairy cows decreases at a very gradual rate with increases in age. This helps to explain the longer herd life of purchased cows.

Although most of the farmers visited had some pasture resources that could be used only by replacements or dry cows, some barn facilities designed for use only by young stock, and additional cow space which

was currently idle or being used to house replacements, the net farm income of a typical dairy farm could be increased by \$500 to \$800 (with 1954-55 prices) by purchasing rather than raising replacements.

Publications

Production Efficiency on New England Dairy Farms, V. Adjustments in Obtaining Dairy Herd Replacements. G. E. Frick and W. F. Henry. N. H. Agr. Expt. Sta. Bul., April 1956.

4. Meeting Dairy Market Sanitation Requirements ARS-PE

A final report was completed on the Doane Contract Study to appraise effects of investment-reducing and labor saving features of dairy farm buildings and equipment on sanitary quality of milk. This study conducted on 15 farms in the St. Louis milkshed suggests that technical progress in handling milk on the farm has created a need for reappraising building, equipment, and practice specifications currently required in the interest of sanitation. On a sample of farms where dairy buildings were constructed or remodeled and equipment was installed to provide for a herd of 20 to 25 cows, the average investment cost per cow at 1950 prices was about \$212. In contrast, acceptable existing dairy buildings and equipment on dairy farms with 20 to 25 cows were valued at \$517 per cow. Dairy chores required only 67 man-hours per cow per year on the former group of farms compared with 119 man-hours per cow per year on the latter group. Yet because good sanitation and cooling practices were followed, 91 percent of the milk samples taken from the farms with the smaller investments in dairy buildings and equipment, compared with 83 percent of the milk samples from a group of reference farms which already were delivering Grade A milk, had bacterial counts within acceptable limits for Grade A milk for fluid consumption.

Plans

To develop an economic study of labor and cost savings potentials in farm service building and related service areas. Rearrangement of the farmstead layout, changes in feeding and other chores routines and related feed-handling practices on dairy farms will be included.

E. DISEASES AND PARASITES

34. Foot-and-Mouth Disease

ARS-ADP

During the past year, an important phase of the work at Plum Island (P.I.) laboratories was the production and stockpiling of foot-and-mouth disease (FMD) and native vesicular disease viruses, as well as their specific antisera. These products are necessary for future research and for differential diagnosis of clinically similar diseases.

Limited electrophoretic studies of FMD antibodies in serum fractions indicates that the major portion of the neutralizing antibodies is present in the Gamma globulin with only a small amount being present in the Beta globulin. Furthermore, the complement fixing antibody was found only in Gamma globulin-1, however, both Gamma globulins showed equal neutralizing activity against FMD virus.

Studies of various tissue culture methods for propagating FMD viruses were fourfold. Before the objectives could be realized with techniques which were adaptable to the virus of vesicular stomatitis (VS), it was necessary to develop a modified procedure. The first phase was the use of tissue culture for assaying FMD viruses and neutralizing antibodies. Cytopathogenic lesions have been observed in the tissue culture cells as early as 3 hours following inoculation of the virus, and one type of FMD virus has been successfully propagated through 70 serial passages. The second phase was the development of a new method of mass production of a high titered FMD virus in tissue culture. The third phase of the work was modification of an existing technique for titration of FMD virus. The new method has a high degree of precision, reliability and reproducibility in determining the number of infectious units of the virus in the original material inoculated into tissue culture, and is less variable than the tube assay method using the 50 percent endpoint. The fourth phase was to obtain fundamental knowledge about production of virus and its stability to pH, to temperature, and to formaldehyde. Maximum production of FMD virus is reached after 11.5 hours of incubation. Precise curves have been developed at different hydrogen ion (pH) concentration and various temperature and in the presence of formaldehyde.

Studies of the relationship of age and heredity to susceptibility of cattle showed that there was no difference in the susceptibility of 2, 6, and 18 months old animals to type A FMD virus. In addition, no difference in susceptibility could be demonstrated in 5 groups of different line bred animals and 1 group of random bred animals from a closed herd.

Studies on inactivation of FMD and VS viruses were continued. Ethylene oxide gas decreases the infectivity of both viruses in cattle tongue epithelium, but more research must be done to determine the exact

potential of this product as a sterilizing agent. Various degrees of heat have been applied to suspensions of both viruses in cattle tongue epithelium, and the results indicate that any except long exposure to high temperatures are inadequate in completely eliminating the infectivity of FMD virus; whereas VS virus was rendered noninfective at temperatures of 56 or 60° for 30 minutes. Final tests for infectivity were determined with guinea pigs, mice, tissue culture, and cattle. These results strongly indicate that final determinations of infectivity must be made in the bovine which is the natural host and which was the most susceptible to the FMD virus.

Plans

Research will continue on improvement of diagnostic tests, on mechanism of infection in cattle, and on propagation of FMD virus under conditions other than in cattle.

Publications

The Growth and Cytopathogenicity of Vesicular Stomatitis Virus in Tissue Culture. H. L. Bachrach, J. J. Callis and W. R. Hess. Jour. Immunology. Sept. 1955.

Isolation of Vesicular Stomatitis Virus from an Infected Laboratory Worker. O. N. Fellowes, G. T. Dimopoulos, and J. J. Callis. Amer. Jour. Vet. Res. Oct. 1955.

Isolation of Vesicular Stomatitis Virus from the Blood of an Infected Worker. O. N. Fellowes, G. T. Dimopoulos, and J. J. Callis. Bacteriological Proceedings - 1955.

Foot-and-Mouth Disease Virus: Its Growth and Cytopathogenicity in Tissue Culture. H. L. Bachrach, W. R. Hess, and J. J. Callis. Science. Dec. 1955.

A Serologic Test for Identification and Titration of Vesicular Stomatitis Virus. G. T. Dimopoulos, O. N. Fellowes, F. V. Washko, and J. Traum. Proceeding of The Soc. Expt. Biology and Medicine. 1955.

Vesicular Stomatitis Virus in Tissue Cultures and Cell Suspensions. H. L. Bachrach, J. J. Callis, and W. R. Hess. Proceedings of the Soc. Expt. Biology and Medicine. 1956.

PROPOSALS FOR
COMMITTEE CONSIDERATION

I. PRODUCTION

1. Improving Dairy Cattle Through Selection and Crossbreeding Techniques

Expand research to determine the effectiveness of crossing breeds which have been selected primarily for milk production and initiate research on the adaptation of our existing breeds, by selection techniques, to the environmental conditions of the South. Past work has demonstrated definite possibilities for increasing production per cow by crossbreeding. Further research on crossing breeds that are primarily known for milk producing ability is of primary importance for the fluid milk market. Current adaptability research includes the introduction of Zebu inheritance and the crossing of European breeds. Results have indicated that a considerable amount of variation in adaptability to hot climates already is present in our existing breeds. A balanced and the most expeditious approach to this problem requires that research efforts be made to develop adaptability in our productive purebreds.

2. Physiological Genetics of Dairy Cattle

Initiate basic research on the inheritance of the dairy cow as it affects milk constituents, feed efficiency, blood antigens and the physiology of milk production, reproduction and growth. For more than a decade dairy cattle breeding research has been concentrated on the gross mechanisms of inheritance for a limited number of characteristics such as milk and butterfat production. As a result information needed today on the inheritance of many important constituents of milk is not available. It will take several years before the current research on solids-not-fat will yield the needed answers on even this constituent. This delay in availability of information can be avoided by establishing genetic research now on the other major constituents including protein fractions and lactose. Breeding programs with other types of livestock have been successful in increasing feed efficiency. Only very limited exploratory studies have been possible to date regarding this characteristic of dairy cattle. This research should be expanded and should include investigations of the influence of feeding and management practices on the expression of efficiency. The blood antigen research should be expanded. The accumulation of information from the decade of studies on the gross mechanisms of inheritance has revealed the need for detailed and basic research on the genetics of the physiological processes involved in milk production, reproduction and growth. This is a practically unexplored field. It can lead to important and possibly new principles for intelligent selection and breeding practice.

3. Improvement in the National Cooperative Dairy Herd Improvement and Sire-Proving Programs

Expand the present program to include the use of electronic-data processing equipment, using magnetic tape, so that it will be possible to utilize the data more completely and on a current basis. Present methods and mechanical processing equipment are inadequate to cope with the volume of data involved in conducting these programs.

4. Parasitic Diseases

Expand research on parasitic diseases of dairy cattle to develop means of controlling them. The manner and extent to which parasitic diseases interfere with breeding, with profitable use of feed and forage, with inter-relationships between dietary factors, and with health, growth, and milk production, are not well understood. Moreover, practical and effective means of prevention, cure, and control are as yet in the formative stage in many cases. An expansion of the work on parasitic diseases is needed if farmers are to be provided with information that can be used in effecting economies in production.

5. Ruminant Bloat

Expand investigations on this important problem which constitutes a serious deterrent to greater utilization of high productive legume pastures and to the use of the better grades of alfalfa hay in some areas. Emphasis should be placed on studies to determine the physiological characteristics of animals bloating under natural conditions, so that field bloat can be correlated with studies on the production of experimental bloat. Special attention should be given to bacteriological aspects of bloat. Studies on the physiology of eructation should be completed and studies on the bacteriological aspects of bloating should be initiated. Work should be expanded on the determination of the chemical, pharmacological and physiological characteristics of legumes and hays that cause bloat, and detailed studies should be initiated to determine the changes in all known and suspected properties of bloating feeds as related to species and varieties, age of plant, diurnal and seasonal growth, climatic factors and plant nutrition.

Expand cooperative investigations with plant breeders and livestock and poultry production groups to isolate, identify, and pharmacologically and physiologically characterize the individual saponins in major forage crops, as a guide to assist in genetic improvement and to provide a basis for improvements in processing, storing, and feeding these feedstuffs. Assay methods for determining the amounts of these significant constituents should be developed as necessary to improving varieties and for devising better processing procedures.

6. Scientific Basis of Milk Quality Requirements

Initiate research on establishing scientific bases for milk quality regulations and developing low cost methods to meet these requirements. The dairymen of the country have been faced with constantly rising costs required by market regulations regarding sanitation, milking and milk handling practices. New methods for determining milk quality are needed to replace those which have no real basis in respect to the production of safe acceptable milk. Changing dairy cattle management and housing practices need to be continually evaluated regarding their effect on milk quality in order that this information may be available to regulatory agencies.

7. Insect Carriers of Livestock Diseases

Initiate basic and applied research on the role of insects as carriers of animal diseases, including research on methods of disease control through control of proved vectors. Anaplasmosis, a widespread livestock disease transmitted by ticks and insects, is an important problem in the livestock industry. Research on the relationships of insects to the disease and specific methods of control are needed. The relationship of insects and other important livestock diseases has not been determined. Research is needed to obtain information on the role of insects to disease transmission and on methods of controlling them.

8. Mosquitoes in Relation to Agriculture

Expand basic and applied research to develop low cost methods of controlling mosquitoes that adversely affect the health and productivity of livestock. The increase of farm ponds and other water sources has intensified the mosquito problem in many areas and hurricanes and floods create acute mosquito situations which are deleterious to both livestock and workers. Although research has developed fairly satisfactory methods of control that are feasible to protect man from attack by mosquitoes and related pests, they are generally impractical in farming areas. Research is needed to devise methods that farm communities and individual farmers can employ to protect their livestock from these pests.

9. Insect Physiology and Toxicology

Expand work on basic insect physiology and toxicology including research on the cause of insect resistance to insecticides, mode of action of insecticides, nature and action of attractants and repellents, and nutritional requirements. Although research has developed substitute organic phosphorus insecticides for controlling flies and mosquitoes which have become immune to DDT and similar materials, there are indications that newer phosphorus materials are failing to give satisfactory control in some cases. In order to prevent or minimize the recurring resistance problem to each new insecticide and to develop

basic information on new methods of insect control, it is urgent to undertake intensive investigations on insects in the areas mentioned.

10. Mineral Interrelationships in Animal Nutrition

Expand studies on mineral interrelationships in animal nutrition. The ways in which the level of any one essential element present in the feed affect the functioning of other elements are not well established. For example in the course of studies on the effect of high levels of molybdenum on the copper status of the animal, the observation was made that a sulfur amino acid would alleviate the growth retardation produced in laboratory animals. This and related observations point to the need for studies such as determination of the effect of varying levels of molybdenum and copper to determine how these elements are interrelated in the metabolism of animals. Such information is essential for an understanding of nutrient imbalancing of rations by mineral elements.

11. Relationships of Protein to Starch Equivalent

Initiate cooperative research to determine what levels of protein in pasture forages are required to bring about maximum production of milk and to investigate this relationship to the starch equivalent of the forage. It is well known that nitrogen fertilization on dairy pastures increases high protein forage production. However, investigations show that dairy cows grazing on these pastures do not produce corresponding increases in milk or butterfat. It has been suggested that the starch equivalent may be as important or more so than the protein and consequently the most desirable ratio of protein to starch equivalent should be determined.

12. Palatability and Consumption of Forages

Initiate and expand research to determine the factors responsible for wide variations in consumption of dry matter of different types and kinds of forages. Studies of the chemistry of forages and a determination of those constituents which appear to affect palatability and consumption should be undertaken. The relationship of these factors to digestibility of feeds should also be studied. Studies on lignin and cellulose and on the nitrogen containing fractions of forages will be required. Animal differences in relation to age, breed and within breeds are also important and should be studied.

13. Fatty Acid Production as Related to Ruminant Nutrition

Expand work to determine the role of fatty acids in ruminant nutrition and to determine those factors which regulate the production and use of fatty acids by ruminants. At present these acids appear to be metabolites of major importance in ruminant nutrition and metabolism.

Information is required on factors which control their production and absorption, on the effects of unbalanced production of the several acids on milk and fat production and on the health of dairy cows and calves.

14. Chemistry and Physiology of Hormones

Initiate and expand work on the basic chemistry and physiology of hormones as a background to the application of hormone chemistry in problems of animal production. This work would include development of analytical methods for the determination of hormones in blood and tissues, studies on the metabolism and excretion of hormones and their action on various tissues using isotopes and other techniques and studies on rates of secretion in relation to problems of reproduction and lactation, as well as solving problems of meat production arising from the use of hormones.

15. Profitable Use of Feed and Forage

Expand research to determine economic feeding rates for all classes of livestock, as well as the economic limits of substituting forage for concentrate feeds and of one kind of feed for another. Also expand economic appraisal of new methods of intensive grazing; new technology in animal nutrition; and aggregative effects of these new developments on demand for various feedstuffs and probable effect on output of different classes of livestock. The need for this kind of research is urgent in view of rapid progress being made in science of animal nutrition and in grassland management. Farmers want information on the costs and income possibilities of these new developments to help them make decisions regarding their livestock feeding and forage management programs.

16. Harvesting, Handling, Storage (Including Storage Structures) and Feeding of Silage

Expand research on harvesting procedures utilizing modern equipment in relation to the best methods of producing good quality silage. Fundamental studies on bacteriological and chemical changes taking place in the silage fermentation process should be expanded. Feeding value and factors affecting consumption of the silage should be studied including input and output relationships when ruminants are fed rations made up of different kinds and qualities of silage. Expand research on types of structures for use in storing silage including sealing of horizontal types of silos; also to include (1) studies on improved construction and use of silos and (2) studies of materials and methods of protecting interiors from deterioration and for resurfacing and protecting the interior surfaces of concrete silos that have been damaged by silage acids.

17. Irrigation and Improvement of Dairy Pastures

Expand research to determine the influence of irrigation on the various types of annual and perennial pastures under differing systems of soil, grazing management, and cultural practices; and investigate irrigation practices in relation to mosquito problems and control.

This work would determine to what extent irrigation may be used in critical periods of deficient rainfall to improve pastures producing larger and more uniform feed supplies for dairy cattle. A shortage of rainfall in critical periods in the humid East is probably the greatest single factor responsible for lack of uniform pasture production. Preliminary results in the Mid-South and East indicate the value of supplemental irrigation for increasing grazing for dairy cattle and maintaining milk production during the summer dry periods. It is necessary to determine the effect of irrigation on types of vegetation, on feed consumption and on nutritive value and production of nutrients in differing locations; and the effects of increased mosquito problems in relation to health and production.

A reexamination of the role of nitrogen fertilizers in irrigated pasture production is needed in view of the present availability of low priced nitrogen. There is need to modify soil and pasture management practices to make the most effective use of irrigation water. In certain areas where drainage is a problem studies will be needed on the effects of varying levels of the water table.

Analyses are needed for different farming and water supply situations of investments, costs, yields and returns to be expected with the installation of irrigation systems and with different irrigation practices. Studies are needed of the supply and prospective demands for water for irrigation and competitive uses, of water laws and regulations to guide in developing legislation to protect investments in irrigation practices.

18. Efficiency and Economy of Dairy Farm Structures, Equipment and Operations

Initiate or expand integrated studies on dairy farm structures, equipment and operations with emphasis on milk, feed, bedding, and manure handling methods and equipment. New developments in buildings and equipment and the need to lower production costs raise many critical problems with respect to the economy and efficiency of dairy farm facilities and operations.

Engineering research is needed on bulk milk cooling equipment to improve equipment performance and reduce operating costs. Despite the current shift toward adoption of bulk milk coolers and the economic studies of this shift, engineering problems of efficient design exist. The adaptability and performance of different types of bulk milk coolers

to different dairy farm situations needs to be investigated. This research should include investigations of the possibilities of off-peak operation. The research would furnish basic data for manufacturing design and guides for selection and management of on-the-farm bulk milk cooling and handling systems.

Research is also needed, which would ignore conventional structures and equipment and puts emphasis on developing cattle housing and management procedures and plans which will contain efficient arrangement and equipment that will utilize new and low cost materials.

Economic studies of mechanization of dairy farm operations are needed to help reduce costs of production and facilitate desirable shifts in production. These studies would include the use of electricity and other kinds of energy in such operations as the handling of milk, feed, bedding, and manure.

19. Effect of Environmental Factors on Dairy Cattle

Expand studies of the relationship of physical environment and its control to growth, health, fertility, production and feed consumption of dairy cattle. Until recently dairy cattle research has emphasized feeding and breeding with relatively little effort to obtain information on the influence of environment. Interest in this phase of animal production is now developing rapidly.

Studies have shown the importance of environmental factors but these studies are just a beginning. They need to be expanded using better laboratory facilities and instruments. A laboratory where all ordinary environmental conditions could be effectively controlled would provide comprehensive information and help to establish a standard for evaluating results obtained under less completely controlled conditions and outdoors. It could serve as a sort of parent station to help co-ordinate studies of environmental influences and to provide facilities for unusually difficult research.

20. Weed Control in Pasture and Hay Crops for Dairy Cattle

Expand research on the control of weeds in the establishment and maintenance of improved grass-legume pastures and hay crops, including those causing off-flavoring of milk, such as wild onion and garlic, bitterweed, etc. Many of these weeds are persistent perennials that cause serious losses to dairy farmers in the humid East. Preliminary studies have demonstrated the potentials of 2-4-D, 2-4-5-T and other chemicals for possible control of certain weeds and brush. Further research on the control of weeds and brush and other practices is necessary for the conversion of brush infested lands to grass in the Lower Appalachian-Piedmont area.

II. UTILIZATION

A. NUTRITIVE VALUES OF FOODS AND FEEDS

1. Food Composition in Relation to Nutritive Value

ARS-HN

For some time questions have been raised about the probable validity of applying available proximate food composition and energy value data to present day foods. To help supply current information, all food samples used for any laboratory purpose are being analyzed to determine proximate composition. Analyses have now been completed of 168 samples from pantothenic acid assays. Among these were Cheddar, processed, and cottage cheese; homogenized, raw whole, skimmed, and non-fat dry milk; and cream. Various dairy products are being included also in analyses underway on fatty acids, amino acids, and vitamin B6.

Plans

This work is being continued.

Publications

A Microbiological Method for Determination of Cystine in Foods.
Millard J. Horn and Amos E. Blum. Cereal Chem. 33, 18, 1956.

Cystine, Tyrosine and Essential Amino Acid Contents of Selected Foods.
Cecile H. Edwards, Lolla P. Carter, and Charlotte E. Outland. Jour.
Agr. and Food Chem. 3, 1955.

Fatty Acid Composition, and Oxidative Deterioration During Storage
of Fats in Cuts of Beef, Lamb, Pork, and Turkey. O. S. Privette,
F. J. Pusch, and W. O. Lundberg. Food Tech. 9, 347-351, 1955.

2. Factors Affecting Requirements for Amino Acids

ARS-HN

Research using laboratory animals is indicating that a number of factors may affect the requirements for amino acids. The amounts and kinds of other nutrients in the diet may determine whether the calories eaten are converted to lean tissues or to fat. With restricted protein intake, diets containing the starches of corn, rice, or wheat, tend to lessen the amount of liver fat, deposited, as compared to a diet containing sucrose as the sole carbohydrate. Threonine has been found to be more effective than any other amino acid or carbohydrate tested, in preventing the accumulation of liver fat under these conditions. More carcass fat, but the same protein content, resulted when penicillin was fed in the presence of corn starch than when fed with sucrose. These studies are showing that data on weight gains and from nitrogen balances must be accompanied by data on tissue or carcass composition.

Plans

This work is being redirected to use intact food protein in place of amino acid formulas.

Publications

Starches, Sugars and Related Factors Affecting Liver Fat and Nitrogen Balances in Adult Rats Fed Low Levels of Amino Acids. Madelyn Womack and Mary W. Marshall. *Jour. Nutrition*, Vol. 57, No. 2, 193-262, October 1955.

The Quantitative Amino Acid Requirements of Young Women. I. Threonine. Ruth M. Leverton, Mary R. Gram, Marilyn Chaloupka, Eileen Brodovsky and Amy Mitchell. *Jour. Nutrition*, Vol. 58, No. 1, 59-81, January 1956.

The Quantitative Amino Acid Requirements of Young Women. II. Valine. Ruth M. Leverton, Mary R. Gram, Eileen Brodovsky, Marilyn Chaloupka, Amy Mitchell and Norma Johnson. *Jour. Nutrition*, Vol. 58, No. 1, 83-93, January 1956.

The Quantitative Amino Acid Requirements of Young Women. III. Tryptophane. Ruth M. Leverton, Norma Johnson, Jean Pazur, and Joan Ellison. *Jour. Nutrition*, Vol. 58, No. 2, 219-299, February 1956.

The Quantitative Amino Acid Requirements of Young Women. IV. Phenylalanine. - With and Without Tyrosine. Ruth M. Leverton, Norma Johnson, Joan Ellison, Donna Geschwender and Florence Schmidt. *Jour. Nutrition*, Vol. 58, No. 3, 341-353, March 1956.

The Quantitative Amino Acid Requirements of Young Women. V. Leucine. Ruth M. Leverton, Joan Ellison, Norma Johnson, Jean Pazur, Florence Schmidt and Donna Geschwender. *Jour. Nutrition*, Vol. 58, No. 3, 355-365, March 1956.

Amino Acid Requirements of Young Women Based on Nitrogen Balance Data. I. The Sulphur-Containing Amino Acids. Marian E. Swendseid, Iona Williams and Max S. Dunn. *Jour. Nutrition*, Vol. 58, No. 4, 493-505, April 1956.

Amino Acid Requirements of Young Women Based on Nitrogen Balance Data. II. Studies on Isoleucine and on Minimum Amounts of the Eight Essential Amino Acids Fed Simultaneously. Marian E. Swendseid, and Max S. Dunn. *Jour. Nutrition*, Vol. 58, No. 4, 507-517, April 1956.

3. Relative Nutritive Properties of Butterfat and Vegetable Fats ARS-DH

When sulfathalidine was included in a purified ration containing 28% fat, weanling rats gained weight more rapidly when the dietary fat consisted of butterfat than when it was composed of corn oil. Some evidence was obtained to indicate that the addition to the basal ration of certain crude food materials would eliminate the growth difference obtained between rats fed corn oil and those fed butterfat but more work is needed before definite conclusions can be drawn. Adding a butter flavor (diacetyl) to the corn oil ration failed to increase the growth rate of rats fed this diet.

Increasing the stress on the animal by including iodinated casein in the ration failed to increase the difference in growth obtained between rats fed butterfat and those fed corn oil. In fact under these conditions, the rats fed corn oil usually grew faster, possibly due to an increased requirement for the essential fatty acids under stress conditions. Various fat levels in the basal ration were tested. The growth differences between rats fed butterfat and those fed corn oil which were found at a 28% fat level disappeared when the fat level was lowered to 10%, while, at a 20% fat level, differences were found in some experiments but not in others.

In preliminary experiments, no marked differences were observed in the various phases of reproduction and lactation between small groups of rats reared to maturity on rations containing the various fats either with or without sulfathalidine.

Plans

Continue studies on the nature of this growth effect and make an effort to determine what factor or factors may be responsible.

Publications

Experiments on the Comparative Nutritive Value of Butter and Vegetable Fats. L. P. Dryden, J. B. Foley, P. F. Gleis and A. M. Hartman. J. Nutrition, 58: 189 (1956).

Reproduction and Lactation of Rats Fed Glyceryl Trilaurate-Containing Diets. L. P. Dryden, P. F. Gleis and A. M. Hartman. J. Nutrition, 58: 335 (1956).

4. Vitamin B₁₂ Potency of Cheese and Other Dairy Products ARS-DH

Comparative rat and microbiological (*L. leichmannii*) assays for vitamin B₁₂ have been made on a number of different samples of Cheddar, Swiss and cottage cheese and other dairy products. This work has now been completed and the results published.

Publications

Vitamin B₁₂ Content of Milk and Milk Products as Determined by Rat Assay. A. M. Hartman, L. P. Dryden and G. H. Riedel. J. Nutrition, 59: 77 (1956).

Comparative Assay for Vitamin B₁₂ in Certain Milk Products by Various Rat Growth Methods. L. P. Dryden, G. H. Riedel and A. M. Hartman. J. Nutrition, 59: 89 (1956).

5. Effect of Vitamin B₁₂ on Protein Metabolism

ARS-DH

When a vitamin B₁₂-deficient ration containing 25% protein was fed to B₁₂-deficient weanling rats, their subsequent four week weight gains were about 50% of normal. An increase in the protein level of this ration to 45% led to weight gains that were only about 25% of normal and a further increase to 65% led to still further reduced growth and, in many cases, to early death. In contrast, when these rations were supplemented with a maximally effective level of vitamin B₁₂, the growth obtained was normal or nearly normal at the 25% and 45% protein levels and about 85% of normal at the 65% protein level.

It is not known whether this growth depression, associated with increased protein level and vitamin B₁₂ deficiency, was due to an increase in protein level as such, regardless of the particular amino acids involved, or whether it was due to an increase in the level of one or more individual amino acids or a combination of certain ones. Preliminary tests have been carried out in an effort to clarify this point. A basal ration containing 20% B₁₂-deficient casein and 5% yeast protein has been used. Most of the amino acids present in casein have now been tested by adding them individually to this basal ration in amounts equivalent to their content in 40% casein. Of the ones tested, only threonine, serine, valine and aspartic acid had a growth-depressing effect equivalent to that obtained with the 65% protein ration. The interpretation of these results is complicated by such factors as the presence of the d-isomers in some of the amino acids tested and the question of possible amino acid imbalance.

Plans

To continue the tests to try to ascertain the effects of the complicating factors involved on the results obtained.

B. CHEESE

1. Improved Methods for Making Cheddar Cheese

ARS-EU

An important feature of the new time- and labor-saving method for making Cheddar cheese is that it can be used with conventional cheesemaking equipment, except for minor changes in hoops and hooping equipment. It is being tested under commercial conditions by numerous cheese factories.

Plans

Some further work will be done on a comparison of the short-time method and the Australian modification of it. Also, application of the method to Blue and Italian-type cheese is anticipated. Major attention will be given to the development of a mechanized procedure for making Cheddar cheese.

Publications

A Simplified Short-Time Method for Making Cheddar Cheese From Pasteurized Milk. H. E. Walter, A. M. Sadler, J. P. Malkames and C. D. Mitchell. EU-73-11. 5 pp. May 1956

Ibid. Abstract. J. Dairy Sci., 39, 917. 1956.

2. Bacterial Starters and Quality of Cheddar Cheese

ARS-EU

Contract research is being initiated to determine the causes of starter failures in the manufacture of Cheddar and cottage cheeses and to develop means for preventing them. Such failures have been frequent in recent years and have become a serious economic problem to the industry.

Research also is being done to obtain conclusive information on the nature and extent of the effects of different species and strains of lactic acid-forming bacteria used as starters on the flavor, body and texture of Cheddar cheese. Different strains of Streptococcus lactis and Streptococcus cremoris have differed greatly in their effects on flavor, body and texture of cheese. The flavor and quality of cheese made with mixed starters has been much better than that made with single-strain starters. S. lactis is much more resistant to salt than is S. cremoris and results indicate that the amount of salt added may have a much greater effect on flavor and texture than has been realized. Cheeses are being analyzed for specific compounds, such as amino acids and fatty acids, to study their possible relation to the desired flavor of Cheddar cheese.

Plans

This investigation will be continued.

3. Amino Acid Content of Cheddar Cheese

ARS-EU

Studies are in progress to improve the development of the desired flavor in Cheddar cheese. Experimental cheeses made with different bacterial starters are being graded for flavor, body and texture and analyzed for amino acids at 3 and 6 months. No correlation has been found between flavor and either the total amino acid content or any single amino acid in spite of marked differences in amino acid content resulting from different starters.

Plans

This investigation will be continued. Cheeses will be analyzed also for fatty acids and other possible flavor components.

4. Identification of Flavors in Provolone and Romano Cheeses

ARS-EU

The aim of this research (contract Ohio Agr. Expt. Sta.) is to determine the effects of different starter bacteria, alone and in combination, on the formation of free fatty acids, free amino acids, aldehydes, ketones, etc., in Provolone and Romano cheeses, and to study the possible relation of such compounds to the desired flavors in these cheeses.

Lactobacillus bulgaricus, Lactobacillus lactis and Streptococcus thermophilus have been found to form different keto acids in cheese. Combinations of these bacteria formed different acids than did pure cultures. The results should be useful in preparing starters for commercial cheese-making.

In related studies, the types of keto acids in cheeses seemed to separate certain cheese into three major classes. Keto acids from lactose and citric acid were characteristic of Brick, Cheddar and Swiss cheese; those from amino acids were characteristic of Camembert and Limburger cheeses; and those from fatty acids were characteristic of Blue, Provolone, and Romano cheeses. The number and relative concentrations of beta-keto-acids in the last class differed sufficiently to characterize each variety.

C^{14} tracer techniques are being used to study the chemical reactions involved in cheese ripening.

Plans

This work will be continued.

Publications

Apparent Selective Liberation of Butyric Acid from Milk Fat by the Action of Various Lipase Systems. W. J. Harper. J. Dairy Sci., 38, 1391. 1955.

Publications (continued)

A Rapid Silica Gel Method for Measuring Total Free Fatty Acids in Milk. W. J. Harper, D. P. Schwartz and I. S. El-Hagarawy. J. Dairy Sci., 39, 46-50. 1956.

Italian Cheese Ripening. IV. Various Free Amino and Fatty Acids in Commercial Provolone Cheese. W. J. Harper and J. E. Long. J. Dairy Sci., 39, 129-137. 1956.

Italian Cheese Ripening. V. Various Free Amino and Fatty Acids in Commercial Romano Cheese. J. E. Long and W. J. Harper. J. Dairy Sci., 39, 1938-145. 1956.

Italian Cheese Ripening. VI. Effects of Different Types of Lipolytic Enzyme Preparations on the Accumulation of Various Free Fatty and Free Amino Acids and the Development of Flavor in Provolone and Romano Cheese. J. Dairy Sci., 39, 245-252. 1956.

Aciduric and Neutral Carbonyl Compounds in Various Cheese Varieties. E. W. Bassett and W. J. Harper. Abstract. J. Dairy Sci., 39, 918. 1956.

5. Microbial Flora Producing Gassy Defects in Swiss Cheese

ARS-EU

This research (contract Uni. of Wis.) is to determine whether the gassy defects in Swiss cheese are produced by specific microorganisms and whether the development of such defects are related to the amount of acid formed by the starter bacteria while the cheese is being made. Results indicate that the lactate-fermenting, gas- and butyric acid-forming, spore-forming anaerobe, Clostridium tyrobutyricum, may be involved in the development of the gassy defects. An associative action of other organisms such as clostridia and pediococci, lactobacilli, or propionibacteria, resulting in increased production of gas, is suspected and is being studied.

Some differences have been found among the abilities of milks from different herds to support the growth of acid-forming starter bacteria used in making Swiss cheese. The cause for such differences remains unknown. Swiss cheese starter bacteria formed the same amount of acid in milks from cows being fed poor-quality grass silage, corn silage, and no silage. The starter bacteria failed to grow in milk from a cow infected with leptospirosis.

Plans

The search for gas-forming bacteria is being continued with particular attention to Cl. tyrobutyricum, alone and in association with other specific organisms.

Publications

General Procedure for Manufacturing Swiss Cheese. G. P. Sanders, H. E. Walter and R. P. Tittsler. USDA Circular No. 851, 20 pp., August 1955.

6. Markers for Detecting Antibiotics in Milk

ARS-EU

The feasibility of adding fluorescent materials or dyes to antibiotics that are to be used in treating mastitic cows has been investigated with the aim of developing a rapid and sensitive method for indirectly detecting antibiotics in milk that is to be used in cheese. Small amounts of antibiotics kill the bacterial starters used in cheese-making.

The results thus far indicate that such a means may be developed. Fluorescent materials and dyes that are shed simultaneously with penicillin, do not affect either the antibiotic or the udder, and can be detected quickly and easily have been found. Fluorescent dyes appear to be the most promising of the materials tested thus far.

Plans

This work will be continued.

7. Other Publications

ARS-EU

Making Cottage Cheese in the Home. CA-E-6. Processed. 5 pp. June 1956

Microbiology of the Surface Ripening of Brick Cheese. D. J. Lubert and W. C. Frazier. J. Dairy Sci., 38, 981-990. 1955.

C. CONCENTRATED AND DRIED MILKS

1. Effects of Heat in Processing and Storing Concentrated Milks

ARS-EU

This work involves the technological phases of research aimed at producing concentrated milks that are chemically and physically stable, do not have cooked flavor, and can be reconstituted to a product resembling fresh milk in appearance and flavor.

Studies on the sterilization of milk by the high-temperature, short-time method (280° F. for 15 seconds) have continued. The milk has been concentrated before sterilization instead of after. This procedure affords a better opportunity of "pilot run" adjustment of the "grain point," and significantly increases the effectiveness of homogenization, which is now possible after sterilization. Preliminary results indicate that the pH of sterilized milk may have an important effect on gelation. Fat separation continues to be a defect which develops early in storage of milk sterilized under these conditions.

Plans

This work will be continued, utilizing the equipment changes for homogenizing after sterilization, adjusting the pH of the sterilized product, and adding salts aseptically to the sterilized product. Various changes involving forewarming the fluid and concentrated products under different conditions will be tried. The addition of "thickening agents" to decrease fat separation will be tried.

2. Puff-Drying of Whole Milk

ARS-EU

A method has been developed for making a powdered whole milk that initially has a flavor indistinguishable from fresh whole milk and that disperses rapidly, even in ice-cold water. Physical tests have shown that the reconstituted milk is identical to fresh whole milk. It is strikingly different from present commercial products.

Results obtained with a batch-type vacuum shelf drier have shown the importance of density, temperature, butterfat dispersion and gas content of the concentrated milk, height and physical form of the puffed structure, and particle size of the powder on the ease of reconstitution of puff-dried whole milk powder.

The results of tests made cooperatively with the manufacturer of a continuous vacuum belt drier and those obtained with the vacuum tray drier indicate that a commercially feasible vacuum belt drier may be devised for successfully puff-drying whole milk.

Storage tests are underway to determine the ability of puff-dried powder to retain its initial excellent flavor and dispersibility. The powder produced thus far does not have satisfactory shelf life, especially with regard to flavor.

Plans

Studies on the physical-chemical changes during storage of the powder and means for preventing them will receive major attention. Further work will be done to adapt the batch-type, vacuum shelf drying procedure to a continuous vacuum belt drier. The effect of variation in forewarming the milk, lactose crystallization, addition of antioxidants, and packing in oxygen-free containers on flavor and physical storage stability will be studied. The flavor and physical stability of low-fat powders also will be studied.

3. Relation Between Salt Equilibria and Heat Stability in Milk

ARS-EU

All of the tests for the characterization of milk (contract Uni. of Minn.) have now been applied satisfactorily to milk. The main part of the program, concerning changes in salt equilibria on heating milks under different conditions, is now underway.

Plans

This work will be continued during the coming year.

Publication

The Relation of Milk Serum Proteins to the Effects of Heat Treatment on Rennet Clotting. A. Kannan and Robert Jenness. Abstract. J. Dairy Sci., 39, 911. 1956.

4. Chemical Changes Caused by Heating Milk

ARS-EU

The objectives of this research are to (a) Identify the chemical changes in the nitrogenous components of milk which may be induced by heat, other processing steps, and storage; (b) characterize the compounds formed; and (c) relate the findings to problems encountered in the processing of sterilized concentrated milks.

A unique physico-chemical substance has been found in heated skim milk. Apparently, it results from an interaction of alpha-casein and lactose. The amount of this substance is increased by increasing the heat treatment or by concentrating the milk before heating. The non-protein nitrogen compounds in fresh milk and those in evaporated whole milk have been isolated. Preliminary tests show that the quantitative distribution of the compounds in evaporated whole milk is different from those in fresh milk. They are being identified. It has been found that more riboflavin was bound by the casein of heated milk than by the casein of non-heated milk.

Plans

This work will be continued. The compounds formed by heat will be identified and studied in relation to the deleterious effects resulting from heat treatment in the processing of milk.

5. Destruction of Bacterial Spores in Milk

ARS-EU

The objective of this research is to find practical methods for sterilizing milk and milk products by means other than high heat, thus avoiding the objectionable flavor resulting from high-heat treatment. The chief problem is to kill the spores of spoilage bacteria.

Viridogrisein, a new antibiotic, in combination with mild heat inhibited the spores of many of the species of spoilage bacteria tested, but it was not effective against others. Nisin, another new antibiotic, was ineffective in low concentrations. A search is being made for substances that will cause the heat-resistant spores to germinate into vegetative cells that can be killed easily by mild heat. Some of the substances tested caused most spores to germinate.

However, none of the many substances tested caused all spores to germinate. An autoclaved mixture of glucose and L-asparagine was the most effective. Kinetin, a plant cell reactivator, had no effect.

The effects of various environmental factors such as pre-storage heating, storage temperature, and pH on the viability of spores have been investigated. Clostridium botulinum was not affected by environment, and Bacillus stearothermophilus was affected only in acidic solutions. Bacillus subtilis was very sensitive to environmental conditions, except in alkaline substrates and at 0° C.

Plans

This work will be continued.

6. Evaluating the Palatability of Processed Milk

ARS-HN

A project (coop. EU) was initiated to determine the functional properties of different market forms of milk in home baked quick bread formulas, to develop standardized procedures for differentiating the cooking quality of market forms of milk, and for evaluating the quality of each baked product.

Work is in progress to select and train taste panels for evaluating the quality of selected market forms of milk. The initial phase in the selection and training of the taste panel involved threshold studies to screen individual tasters for their sensitivity or taste acuity for certain flavors (foreign or off-flavors) in milks. This involved tasting 20 pairs of milk samples. Each pair of samples consisted of an untreated control sample of milk and a treated sample of milk composed of a certain amount of the flavor under study diluted with the same milk as was used in the control sample. The dilution of the flavors was varied from day to day as determined by the results of the preceding day. The results were evaluated statistically to ascertain the sensitivity of the individuals for taste panel work. The second phase in the study involved training individuals to evaluate various undesirable flavors in milk that might be encountered in samples under investigation in processing and storage studies.

Plans

This project will be continued.

Publications

Get More Good From Milk. Processed Publication, ARS 61-3, 15 pp., May 1956.

Recipes - Type A School Lunches. P.A. 270, June 1955

Food Buying Guide for Type A School Lunches. P.A. 271, June 1955.

D. BUTTER AND BUTTERFAT

1. Composition of Butterfat

ARS-EU

Sterols and unsaturated fatty acids have achieved attention for their alleged relationship to arteriosclerosis. Both of these types of compounds are minor components of butterfat. Work has been initiated on their isolation and identification.

Recently-developed chromatographic techniques should make feasible the separation of the steroids in milk fat, including some of those present only in trace amounts, at least into the steroid types which have been found in other biological materials. It may even be possible to isolate the individual compounds and to determine the approximate concentration of each. Even though the general fatty acid composition of butterfat has been studied repeatedly, those fatty acids occurring as minor components, particularly the ones more unsaturated than oleic, definitely need more complete identification. Concentrates of this group of acids have been prepared from one large sample of butterfat.

Plans

This work on the steroids and unsaturated acids will be continued. Purification and identification of the individual components will be pursued.

2. Canned Butter

ARS-EU

This work is aimed at producing a canned butter of satisfactory properties and long storage life. The keeping quality of butter canned in nitrogen was little, if any, different from that canned in air. The keeping quality of dried butter was slightly better than that of butter stored at 0° C.; definitely better than that at 10° C.; and much better than that at 20° C.

Plans

This work is being continued, with major attention to the effectiveness of antioxidants.

3. Relative Keeping Quality of Butter and Butteroil

ARS-EU

Research has been started to determine the advisability of converting different grades of butter to butteroil in order to extend their storage life. The significant conclusion thus far is that the quality of butteroil made from butter that has undergone some protein degradation is much better than that made from butter that has undergone fat deterioration. The protein degradation products are removed in the

serum during the conversion of butter to butteroil, whereas the products of fat deterioration are not removed.

Plans

This work is being continued.

4. Detergent Tests for Butterfat in Milk

ARS-EU

A comparison was made (coop. DH, Uni. of Md., and D. C. Health Dept.) of the detergent tests with the official tests of the AOAC - the Babcock and Mojonnier (ether extraction) methods. The detergent tests were found to be slightly less accurate and reproducible than the Babcock test, but do have advantages of safety and convenience. The results indicate that they would not be as satisfactory for use in commercial processing and handling of milk as the official tests, but are certainly sufficiently accurate for culling herds.

Plans

This work has been completed.

Publications

A Detergent Test for the Milk Fat Content of Dairy Products. I. Milk, Cream, and Ice Cream. O. S. Sager, G. P. Sanders, G. H. Norman and M. B. Middleton. J. Offic. Agri. Chem. 38, 931-940, 1955.

E. MILK CONSTITUENTS

1. Separation of Pure Milk Proteins

ARS-EU

The protein associated with the cream fraction of milk and commonly called the membrane protein has been found to be a mixture of proteins. It was found that this protein constitutes a large aggregate of molecules containing the enzymes phosphatase and xanthine oxidase, as well as other proteins.

Further fractionation of milk whey has led to the purification of a red-colored protein, which contains iron but apparently has no enzyme activity. While the amount of this protein in whey is not large, it could be of significance in the nutritional properties of milk.

Plans

Work in the field of the separation of milk proteins will be continued. The project on the membrane protein has been discontinued.

Publications

Determination of Xanthine Oxidase in Milk with Triphenyl Tetrazolium Chloride. C. A. Zittle, E. S. DellaMonica, J. H. Custer and R. K. Rudd. J. Dairy Sci. 39, 522 (1956).

The Fat-Globule Membrane in Milk: Alkaline Phosphatase and Xanthine Oxidase in Skim Milk and Cream. C. A. Zittle, E. S. DellaMonica, J. H. Custer and R. K. Rudd. J. Dairy Sci., 39, 528 (1956).

Preparation of Alpha-Lactalbumin. W. G. Gordon and J. Ziegler. Biochem. Preparations 4, 16 (1956).

2. Gels from Purified Milk Proteins

ARS-EU

The instability of the milk proteins during the storage of concentrated milk products has to a large degree prevented the development of a concentrated milk with the quality of fresh milk. One of the most obvious indications of the instability of milk proteins is the formation of precipitates or gels in stored milk concentrates. Factors involved in the precipitation of proteins in simple systems are being intensively studied as a guide in understanding and controlling undesirable changes in concentrated milk products. Results obtained indicate that the major factors in heat stability of milk proteins are the calcium concentration, pH, the ratio of calcium to protein, and the time of heating.

Plans

Work in this field is being continued.

Publications

Viscosity and Flocculation of Heated Beta-Lactoglobulin Solutions: Effect of Calcium Concentration and pH. C. A. Zittle, E. S. DellaMonica, J. H. Custer and R. K. Rudd. J. Dairy Sci., 39, 514 (1956).

3. Structure of Milk Proteins

ARS-EU

Studies on the structure of casein have been concerned with the separation of phosphopeptides obtained by the partial splitting of pure caseins with acid and enzymes. No evidence has been found for the presence of any type of phosphorus linkage in casein other than the combination of phosphorus with serine in the form of a mono-ester. Beta-casein, with a molecular weight of 24,000, was split by the enzyme trypsin into a number of fragments, one of which was a phosphopeptide. It contained 4.3 percent phosphorus and eleven different amino acids. Methods are being developed to reduce the number of split products produced by the action of enzymes on milk proteins in order to simplify and expedite the determination of the milk protein structures.

Plans

These investigations are being continued.

Publications

Nomenclature of the Proteins of Bovine Milk. Robert Jenness, B. L. Larson, T. L. McMeekin, A. M. Swanson, C. H. Whitnah and R. McL. Whitney. *J. Dairy Sci.* 39, 536 (1956).

Phosopeptides Obtained by Partial Acid Hydrolysis of Alpha-Casein. N. J. Hipp, M. L. Groves and T. L. McMeekin. *Abst. of Papers, 128th Annual Meeting of the A.C.S., Minneapolis, Minn. Sept. 1955, P. 22C.*

Phosphopeptides Obtained from Alpha- and Beta-Casein by Partial Hydrolysis with Pepsin. M. L. Groves, N. J. Hipp and T. L. McMeekin. *130th Annual Meeting of the A.C.S., Atlantic City, N. J., Sept. 1956, p. 33C.*

4. Physical Properties of Milk Proteins

ARS-EU

It was found by light-scattering and ultracentrifugation that the size of beta-lactoglobulin is a function of temperature, pH, ionic strength, and dielectric constant of the medium. It was found that aggregation takes place in the region of pH 4.5. Below pH 3.5 the molecular weight was found to be one-half as great as the normal value.

Plans

This work is being continued.

Publications

The pH dependence of the association of beta-lactoglobulin. R. Townend and S. N. Timasheff. *Arch. Biochem. and Biophys.* 63, 482 (1956).

5. Physico-Chemical Studies of Milk Components

ARS-EU

The objective of this research is to determine changes in the sizes of the protein complex particles in milk which may be induced by heat, other processing steps, and storage, to determine the characteristics of the various size groups, and to relate these findings to problems encountered in the processing of sterilized concentrated milks.

Earlier findings that heat/milk contains approximately equal numbers of very large and relatively small particles, and that the large particles contain a greater proportion of calcium and phosphorus than the small particles, have been confirmed with increased precision of measurement. It has been shown also that the heat-produced small particles are of two kinds, one derived from the casein-containing colloid and the other from the serum proteins.

The structural viscosity of heated milk, which leads to gelation, has been shown to be due to the small particles and not to the large ones. There is evidence that both the casein-derived and serum-derived particles contribute to this structural viscosity.

Plans

Further studies of these heat-induced changes are planned. Various temperatures and heating schedules will be employed to obtain a better understanding of the factors controlling the rates and extent of the colloidal and other reactions involved, and to develop means of controlling or modifying these changes.

Publications

An Air-Driven, Air-Floated Capillary Tube Ultracentrifuge. T. F. Ford, G. A. Ramsdell, and Loraine W. Klipp. *J. Phys. Chem.*, 59, 922-929 (1955).

Composition of the Casein-Containing Particles in Milk. T. F. Ford, G. A. Ramsdell, and Shirley G. Landsman. *J. Dairy Sci.*, 38, 843-857 (1955).

Calibration of a Stroboscopic Light. T. F. Ford and T. G. Alexander. *J. Scientific Instruments*, 33, 204 (1956).

6. Organic-Chemical Studies of Milk Constituents

ARS-EU

Studies of the effects on milk of a particular phosphate, sodium tetra-metaphosphate, show that this reagent will reduce about 80 percent of the polydisperse casein colloid particles in raw milk to particles of uniform size and approximately 500,000 molecular weight. This mono-disperse form of the colloid contains 40 percent more organic phosphorus than does the normal casein-containing colloid. It has been previously found that other treatments and reagents produce similar effects, suggesting the existence of a definite unit casein molecule or particle. It has been established that magnesium is associated with the casein-containing colloid in milk, and that it is present in fairly constant proportion to calcium. It has also been shown that the citrate ion is not associated directly with this colloid.

Plans

This work will be continued.

Publications

Report on Microanalytical Determination of Phosphorus. C. L. Ogg. *Jour. Assoc. Offi. Agr. Chemists*, 39, 408-9 (1956).

F. DAIRY WASTE DISPOSAL

1. Laboratory Studies

ARS-EU

During the course of this work it became of interest and importance to identify the microorganisms involved in the rapid oxidation of dairy waste. In the actively assimilating aerated sludge it was found that 84% of the bacteria were numbers of the genera Bacillus and Bacterium. Numerous varieties of nematodes and protozoa also were present, indicating that the milk solids were completely utilized, since these organisms do not survive under polluted conditions. Research is being directed to the oxidation of cheese whey by micro-organisms. The effect of added supplements on the rate of oxidation of cheese whey is being studied. Also, methods of producing useful products from whey such as enzymes, vitamins, and feeds by means of microbial action are being investigated.

2. Pilot-Plant Study

ARS-EU

The pilot-plant evaluation (contract Pa. State Uni.) of the aeration process for biological oxidation of dairy waste has been completed and the project discontinued. A final report summarizing this work and two sets of designs were prepared by the contractor, one to handle 10,000 gallons of waste and one for 25,000 gallons. A technical report of the work and a bulletin describing this work are being prepared for publication.

Plans

This work has been discontinued.

Publications

Simplified Dairy Waste. R. R. Kountz. Milk Products J., Nov. 1955.

Dairy Waste Treatment. R. R. Kountz. Milk and Food Tech. 18, 243 (1955)

Improved Methods of Dairy Waste Disposal. S. R. Hoover. Proc. 25th Ann. State Coll. of Washington, Inst. of Dairying, p. 155, March 1956.

3. Field Study

ARS-EU

A continuous treatment process (contract Dushore, Pa.) for this large dairy plant has been designed and is being successfully operated. It was found that, although bacterial cells can serve as fish food, the passing of aerated sludge into a small stream is not feasible, since the sludge settles in pools and holes producing septic conditions.

Plans

This study is essentially complete. The plant design and final report were expected to be completed by Nov. 1956.

4. Spray Irrigation

ARS-EU

This effectiveness of spray irrigation (contract Uni. of Wis.) as a method for the disposal of dairy plant waste is being studied. This method of treatment of dairy waste may prove simple and particularly effective in some localities. This study is planned to give information as to conditions that will favor the use of spray irrigation. Types of soil, permeability, organic matter, topography, climate, are a few factors that will be considered. Information concerning equipment will also be recorded.

5. Costs and Benefits from Treatment and Disposal of Dairy Processing Plant Wastes

AMS-OC

Research under this contract study at Iowa State College has been completed. The final report on the study is now being revised for publication. This report will provide managers with much needed economic-engineering data for 11 model trickling filter plants of two types and 6 different sizes. Detailed estimates on construction and operating costs and labor, power and equipment requirements will be presented to aid plant managers in making decisions on the construction and operation of waste treatment plants. The report will show dairy plant managers a number of ways of reducing wastes and of, thereby, greatly increasing net returns. A careful review of literature on treatment of dairy plant wastes will be included. The report probably will be ready for public release early in 1957.

G. CONSUMER USE RESEARCH

1. Food Consumption and Dietary Levels of Rural Families

ARS-HHE

Food consumption and dietary levels of rural families in the North Central region have been investigated as a basis for educational programs of teachers, nutritionists and extension workers and for policy and program decisions of USDA administrators and others interested in levels of living of rural families. The data were collected from a sample of 1,152 families. A report prepared for publication during the year summarizes the information on quantities and expenditures for food used during a week, the amounts that were purchased or home produced, the nutritive content of the week's food and the variations in these respects among different groups of families.

Milk in its various forms made an important contribution to the diets of these families. Consumption was equivalent to 5.6 quarts per person per week in farm households and 4.6 quarts in those of rural nonfarm

families. About three-fourths of the farm families used home produced milk during the week; only about 5 percent of the rural non-farm families had milk from this source. Of the fresh fluid milk used, about two-thirds was used as a beverage by both groups. Next most important uses were for cooking and on cereal for which farm families used 16 and 14 percent respectively and rural nonfarm 12 and 15 percent.

Many rural families used evaporated milk (16 percent of the farm, 39 percent of nonfarm) during the week of the study but few used any nonfat dry milk. Milk, in all forms, plus cheese and ice cream, accounted nearly half of the riboflavin, a fourth of the protein, and important amounts of vitamin A.

Two bulletins on this survey complete the presentation of the basic data.

Plans

Attention will be directed next toward estimating and interpreting trends in farm family food consumption.

2. Basic Data for Food and Nutrition Programs

ARS-HHE

Research findings from several projects have been used in the development of information on the essentials of an adequate diet. The most recent research on human nutritional needs (expressed in terms of recommended dietary allowances), nutritive value of foods, and food consumption habits provides the basis of the recommendations. Special emphasis has been given to the nutrients most likely to be short in American diets, and to foods that are good sources of these nutrients. Because different kinds of foods can provide the essential nutrients and because food supplies in this country are ample to provide considerable freedom of choice, a point system has been developed to show how common foods rate as sources of key nutrients. Using this system, foods within the basic plan can be interchanged to allow for differences in availability and cost of foods, food preferences, and other factors. This information will be useful to nutritionists, extension workers and others who are teaching the principles of good food selection. It is part of a project dealing with basic data for nutrition programs designed to meet the continuing demand for authentic information on food values, diets, and other subjects related to nutrition.

Plans

Expand this project to cover additional topics and cooperation with information and education specialists in the preparation of popular materials and teaching aids.

3. Composition and Nutritive Value of Foods

ARS-HHE

Continuing work is required to prepare and keep up-to-date suitable tables of the composition and nutritive value of foods. One of the segments completed during the year was a Handbook on physical yields and losses or changes that occur in food preparation. Information has been brought together from many laboratories on how much meat, fruits, vegetables and other foods purchased on the market can be expected to yield as food ready to eat. The publication "Food yields---summarized by different stages of preparation" gives dietitians and food managers an up-to-date guide for planning food purchases for school lunchrooms, hotels, restaurants, the armed forces, hospitals, and other institutions. The data take account of present-day practices in processing and marketing food and new developments in breeding plants and livestock that affect yields not reflected in earlier less comprehensive summaries of yield data.

Plans

Work has been started toward establishing channels for securing unpublished analytical data to use in a contemplated revision of Handbook 8 "Composition of Foods...raw, processed, prepared." The many new forms of food being marketed and the additional nutrients for which summaries should be prepared make this a large undertaking.

Publications

Food Expenditures of Households in the United States. Preliminary Report, Household Food Consumption, 1955. Aug. 1956.

Food Consumption and Dietary Levels, Rural Families in the North Central Region, 1952. M. Orshansky, C. LeBovit, E. C. Blake, and M. A. Moss. AIB _____. 1956.

Effect of Food Losses on Nutritive Content of Diets in Four Institutions. Constance L. Brine and Edith B. Tate. Jour. Amer. Dietet. Assoc. 32, Jan. 1956.

Food Expenditures in Four Institutions. Faith Clark and Edith B. Tate. Jour. Amer. Dietet. Assoc. Sept. 1956.

Nutritive Values of Per Capita Food Supply, Table and Nutritional Review in National Food Situation. Oct. 1955.

Nutrients Contributed by Major Food Groups--A Reflection of Changing Food Habits. Eloise Cofer. National Food Situation. Oct. 1955.

Essentials of an Adequate Diet--Facts for Nutrition Programs. L. Page and E. F. Phipard. ARS 62-4. June 1956.

Diet and Serum Cholesterol in Men: Lack of effect of dietary cholesterol. A. Keys, J. T. Anderson, O. Michelsen, S. F. Adelson, and F. Fidanza. Jour. Nutr. 59(1) 39-56. May 1956.

Bread, Facts for Consumer Education. I. H. Wolgamot and L. J. Fincher. AIB 142. Nov. 1955.

Food Yields, Summarized by Different Stages of Preparation. R. Pecot and B. K. Watt. AH 102. July 1956.

PROPOSALS FOR
COMMITTEE CONSIDERATION

II. UTILIZATION

1. Food Consumption and Dietary Adequacy

Expand statistical research on food consumption and nutrient appraisal of diets of population groups to show the contribution of dairy products and other foods to diets and to provide a base for food and nutrition programs. Especially needed is information on the division of food supplies among family members, the contribution to diets of food eaten away from home, the extent to which family diets vary with the seasons, and the deductions to be made from food supply estimates for household waste, as well as extension and improvement of the tables of food composition.

Programs of the Department, as well as those of other agencies and State and local programs of nutrition education, depend on knowledge as to whether we are as a nation well fed, the groups least likely to have good diets, the nutrients most lacking in diets and the foods that provide them within current patterns of food habits. To meet these needs, up-to-date information on food consumption is required, together with the means of making dietary appraisals. A recent survey has provided new data on consumption, but little is known about household waste, variations by seasons of the year or among individuals of various ages, and the effect of these factors on dietary adequacy or market potentials. Moreover, present food composition tables, which are the basis of dietary appraisals and have other uses also, should be extended to cover new foods and additional nutrients.

2. Nutritional Values and Requirements

Expand research on human nutrition, including nutritional values of dairy products and other foods. Areas of work needing particular attention include replacement of obsolete data on carbohydrate values, determination of kind and quantity of organic acids, factors affecting amino acid requirements, role of fat and fatty acids in human nutrition, determination of human requirements for newer vitamins, physiological

availability of nutrients from different foods, and effects of new methods of cooking, processing and handling on acceptability and nutritive values.

It has long been recognized that diet affects the health and vitality of people at every stage of the life cycle. We have knowledge of the importance of proteins, minerals, and vitamins, but this is only the first step in our understanding of the needs of the human body. The degree of need differs for children, youth, young adults, and older people, and with the kinds of foods and combinations in diets.

Very little is known about the functions of the various nutrients or the long-time effects of different levels of intake. Work under way indicates that there are unfavorable relationships among nutrients which may cause a chain of metabolic disturbances that make for premature degenerative damage to vital organs. A current nutrition problem is how adults of this country may avoid excessive body weight and other diet-related conditions that lower efficiency and shorten life expectancy. Satisfactory solutions are unlikely until we know more about what food elements the body needs, and from what combination of sources they can best be obtained from the standpoint of nutritive content, physiological value and acceptability of foods.

3. Improved Evaporated and Dried Milks

Expand research on evaporated and dried whole milks in order to produce more generally acceptable products that will stand up under conditions of storage. There is need to develop a procedure to prevent discoloration and flavor deterioration during processing and storage of evaporated milk, with special emphasis on the cause of fat separation and gelation. The impairment in flavor and dispersibility of dried whole milk during storage makes necessary a study of the chemical changes involved and the development of a product of adequate storage stability.

4. Dairy Waste Disposal

Expand research on dairy waste disposal, especially the development of useful products from cheese whey. It has been shown that micro-organisms convert milk solids into cellular material with a high degree of efficiency. It is proposed to apply this finding to the production of high quality feeds, of enzymes, and of vitamins from cheese whey by means of microorganisms.

5. Milk Constituents

Expand research on the separation, identification, structure, and properties of milk constituents to provide a practical basis for controlling the changes that they undergo during the processing and storage of milk and milk products. Additional research is greatly

needed on the shape and particle size distribution of proteins of milk and on the chemical composition differences among the various sizes with special attention directed to the relation of such differences to heat-induced changes, such as gelation and coagulation, accompanying the processing of milk and milk products. Specific characterization of proteins, colloidal complexes, fat, phosphopeptides, minerals, and enzymes in milk will aid greatly in devising practical means for preventing deteriorative chemical reactions during manufacture and storage, aid in decreasing cost of processing, and insure uniformity of products.

6. Improved Quality of Butter

Expand research to improve the physical properties and stability of butter. Basic research on the physicochemical composition of butter, including the fatty acids, specific flavor components, and minor constituents, is needed to provide a basis for developing practical means of consistently improving and stabilizing the desired flavor of butter. The cause and prevention of oxidative deterioration in butter should be investigated. The application of the knowledge and techniques of the fat and oil industry to producing butter of improved properties should be a profitable approach.

7. Improved Quality of Cheese

Expand research on the chemical, microbiological and technological factors in the production of cheese of various types of improved flavor, texture, and consumer acceptability; extend the short-time method of making Cheddar cheese to blue and Italian-type cheeses, and initiate research on the development of labor-saving, semi-continuous, mechanical methods for making cheese. Research is needed to develop practical means for reducing manufacturing costs and improving the quality of cheese in order to increase cheese consumption and thus provide an increased outlet for milk.

8. New Milk Products

Expand research to develop new acceptable milk products, such as low-fat dried milk; solid confections consisting principally of milk solids; and stable, dried milk prepared with a variety of flavors that can be easily reconstituted for home consumption.

III. MARKETING

A. COSTS AND EFFICIENCY

1. Yields of Dairy Products

AMS-OC

The average yield of nonfat dry milk from a unit of milk found in this study was 8.16 pounds of nonfat dry milk per hundred pounds of whole milk, and 8.98 pounds per hundred pounds of skim milk. The average loss of milk solids in drying was 4.04 percent, as compared with an average moisture content of 3.0 percent in the nonfat dry milk. On the average, losses of solids in drying exceeds overrun due to moisture in the powder. Yield of nonfat dry milk varied 1.0026 pounds \pm 0.22 pound per hundred pounds of liquid skim milk for each 1 percent change in solids content of the milk.

It is possible to estimate yield from the butterfat content of whole milk. For milk separated into 40 percent cream and skim milk, the yield of nonfat dry milk varied 0.4863 pound \pm 0.207 pound per hundred pounds of liquid skim milk for each 1 percent change in the butterfat content of the whole milk.

With the publication of a final report, the study was concluded.

Publications

Yield of Nonfat Dry Milk Solids From a Unit of Milk. Anthony G. Mathis and Elsie D. Anderson. Marketing Res. Rpt. No. 126, June 1956.

2. Butterfat Sampling and Testing

AMS-OC

In the study of the expected accuracy of various butterfat testing programs, collection and electronic processing of daily sampling and testing data in nine markets will be completed in fiscal year 1957. Calculations and comparisons will be made of differences between various simple and weighted averages of both producer and plant tests, and between fresh and composite sample tests. The variability of producer and plant average tests and deliveries will be measured and a study will be made of the relationships between such variabilities and several factors including environmental temperatures, seasons, size of plant, geographical location of markets, etc.

An analysis of the differences between tests of loaded tanker samples taken from various positions and the weighted average test of the commingled shipments has been made in one market. The findings, which may have important uses in regulatory work and plant butterfat control, are to be checked by similar studies in other markets. Data are being collected on the costs of testing programs and the test variability that could be attributed to the use of different testers and sampling and testing techniques.

3. Costs and Efficiency in Distributing Fluid Milk

AMS-OC

Data pertaining to margins, costs, and input-output relationships were collected quarterly from 80 fluid milk plants in the form of punched cards, submitted by the contractor. Machine tabulation of the cards was carried on concurrently with the collection of data. Data series on costs and margins were maintained currently. Comprehensive analysis of all data received since the beginning of the project was made and results incorporated in a manuscript. Brief highlights of the project were reported in Department situation reports and in addresses at industry meetings. Under the current contract, data will continue to be furnished for plant operations through June 1957.

4. Outdoor Vending Machines in Areas of Sparse Production

AMS-OC

Cost data on two wholesale dairy routes near Denver, servicing ice cream and outdoor milk vending machines, have been analyzed (coop. Colorado A & M College) and a final report prepared. This report analyzes the fixed and variable cost for the vending machine stops and uses the cost data to calculate the break-even points for the operation, both under existing conditions and for various hypothetical volumes.

5. Costs and Efficiency of Distributing Milk Through Vending Machines

AMS-OC

Data on labor requirements, wages, vehicle and other costs have been collected in Martinsburg, West Virginia, in order to determine the costs of merchandising milk through vending machines relative to other methods. Data were obtained the first month of each quarter of the calendar year 1956. It is expected that data analysis will be completed and a report prepared in 1957. This project is correlated with a study of the impact of introducing milk vending machines on total milk sales in selected markets.

6. Farm-to-Retail Price Spreads for Dairy Products

AMS-OC

Studies of price spreads from farm to consumer have been under way on fluid milk, cheese and butter. For Cheddar cheese, a study of marketing costs and services at each step of the marketing channels is being made (contract Uni. Tenn.). A similar study (contract Uni. Wis.) has been initiated for Cheddar cheese, processed cheese, and rindless block cheese produced in Wisconsin. Studies of margins on fluid milk are in progress in the Chicago, Ill. and Akron, Ohio marketing areas (coop. Ohio Agr. Expt. Sta.). Consumer surveys have been made to determine prices being paid by consumers; payments to producers have been determined in cooperation with market administrators and others; other services and charges have been determined to aid in explaining segments of the margin.

Margins in the marketing of butter are being studied on the basis of observations of specific shipments of butter from 10 creameries in the States of Minnesota and Iowa. In each case, data are being collected with respect to payments received by farmers for butterfat and the prices, charges and services performed at each step of the marketing process.

Plans

Price spreads for nonfat dry milk in consumer packages will be studied during the coming year.

Publications

Marketing Costs and Margins for Fresh Milk. USDA Misc. Pub. 733. Oct. 1956.

The Price of Milk. USDA Leaflet No. 409. Oct. 1956.

Marketing Margins for Dairy Products. USDA, AMS-113. 1956.

7. Plant Sizes and Product Combinations for Small Milk Plants AMS-OC

This study (coop. Uni. Idaho) was concluded with the publication of a report.

Publications

An Economic Study of Small Fluid Milk Plant Problems in Northern Idaho. Idaho Agr. Expt. Sta. Bul. No. 255, March 1956.

8. Improved Work Methods, Equipment, and Facilities for Fluid Milk Plants AMS-TF

This research is being conducted (coop. Georgia Agr. Expt. Sta.) to reduce operational cost and otherwise increase the efficiency of fluid milk plants. Field studies which consisted of time and motion studies of plant operations, ascertaining equipment costs, and obtaining plant layout and operational diagrams were completed, and an analysis of these data were started. A preliminary analysis indicates that improved work methods, equipment costs, and plant layouts should be developed for at least two plants, one doing a volume of 6,000 gallons daily and one doing a volume of 10,000 gallons daily, to provide dairy operators with adequate information for improving work methods and plant inefficiencies.

Plans

Work on the study will be continued.

9. Cheaper or Improved Containers for Fluid Milk

AMS-TF

Preliminary investigations were made to determine the present status and need for research in the milk packaging field. Containers for milk, it was found, must serve at least 3 distinct markets, each with somewhat different requirements. These markets may be identified as (1) home deliveries, (2) retail store sales, and (3) institutional feeding. Each of these segments in turn may be subdivided. The third listed market segment, for example, includes (1) hotels and restaurants with table service, (2) cafeterias, (3) lunch counters and refreshment stands which serve milk for on-premise or off-premise consumption or both, (4) the armed services, school lunches, hospitals, industrial or office workers' lunches, asylums and prisons. This last market subsegment in itself diverse, is bound together by a common characteristic. Each, in varying degree has what might be termed a "captive clientele." Because of their circumstances, the consumers' preference does not carry the same weight it might in other market segments.

Manufacturers are now experimenting with containers of revolutionary design and shape. Some are round, some square and some pyramidal. New methods of fabrication are being tested. New materials--including the latest products in the field of plastics--are being tried. Some of these containers have reached the development stage where they merit critical comparative evaluations.

Packaging of milk for the school milk program was selected for initial research because (1) this market area has homogeneous requirements, (2) it is growing rapidly, and (3) the containers used and the methods of service give little evidence of any trend to standardization.

Plans

To make evaluations of newly developed containers--first in the school milk program field and later in other fields.

10. Economic Aspects of Bulk Transport of Milk

AMS-TF

This project (contract Uni. New Hampshire) is for the study of economic aspects of bulk milk transport from farms to plants in the Boston milk-shed. Because of dairy farms in that region are generally of small or medium size, bulk milk pickup has both advantages and disadvantages. Most of the field work, covering operations in Maine, New Hampshire, and Vermont, has been completed. Data collected include costs, rates, facilities, comparative efficiency of operation, business structure and practices, and related information.

Plans

Analysis will be made of the comparative advantages and disadvantages of bulk milk transport in that area from the standpoint of shippers, haulers and receivers. Particular consideration will be given to optimum sizes of tank trucks under varying conditions and the feasibility of transfers from small pickup trucks to large transports for delivery to the metropolitan markets.

11. Milk Meter for Bulk Tank Trucks

AMS-TF

A preliminary study and examination of available volumetric fluid meters to determine their possible application to metering the flow of milk from the refrigerated farm tank to the bulk milk truck has been completed. Of the many examined in cooperation with the National Bureau of Standards, only a limited number appear to be sufficiently rugged and simple in design to install and test on a tank truck. Before any meter can be used with a reasonable assurance of accurate performance, it will be necessary to obtain a practical air eliminator to place in the line ahead of the meter. An accumulation of air occurs in the milk stream, especially in the slugs of air at the beginning and end of a farm tank pickup. This is the major obstacle to applying meters to truck tank service. No satisfactory equipment for eliminating the air is available at present.

Plans

Bureau of Standards engineers believe a solution can be found to the problem of air elimination, and work by the Bureau along this line is now being considered. Developments that may arise from industry research in this field will be followed, and, where feasible, new equipment designed for this purpose will be evaluated.

12. Improved Methods, Operating Practices, Equipment, Materials, and Layout for the Dairy Operation in Retail Stores and Central Warehouses

AMS-TF

A preliminary survey of current handling practices in retail stores and some detailed data from one firm were made.

Plans

Studies will be made of the dairy operation both in retail stores and central warehouses to determine present costs for alternative methods, equipment, and layout. Any improvements developed will be installed in test stores and the results measured. Studies are also planned to compare the costs of preparation (processing, packaging, or pricing) of dairy items in the retail store and in the central warehouse.

13. Potentialities of Frozen Concentrated Milk

AMS-OC

As part of cross-commodity research on frozen foods, the possible effect of frozen concentrated milk on the demand and market structure for fluid milk was studied. Costs, acceptability, and keeping quality for frozen concentrated milk was obtained mainly from secondary sources. Frozen concentrated milk is acceptable from the viewpoint of keeping quality, but the costs of the product at consumer levels can be expected to be above those for fresh fluid milk, unless new and lower cost processing and distribution methods are found. The product has promise for special outlets such as use on ships, where keeping quality and space conservation is important, and where below zero storage space is available.

In the course of this work, the opportunity was taken to obtain and analyze data on other forms of concentrate milk to determine their market possibilities. A report was prepared for use in the frozen food study, and a second manuscript covering all forms of concentrated milk is being prepared.

14. Economic Impact of Bulk Milk Assembly

AMS-OC

Under the study of the impacts of bulk assembly and farm handling of milk on market organization and practices: (1) A literature review summarizing and appraising results of previous research and published reports of commercial operating experience has been completed and is being readied for publication; (2) preliminary work has been completed on the task of synthesizing relative costs of farm cooling, plant receiving, and farm-to-plant assembly of milk; and (3) findings to date on these phases have been made available in published form to the dairy industry and the general public.

Plans

Future work will include (1) field interviews and surveys with milk market administrators, personnel of producers' cooperative associations, and operators of milk plants, milk hauling routes and dairy farms, with respect to changed practices, costs and problems accompanying the shift to bulk handling; (2) analysis to determine and appraise likely changes in milk market organization and practices, problems of small-scale plants and farms, provisions of Federal milk-marketing orders, and other impacts of bulk assembly, including possible changes in the scope and practice of sanitary and marketing regulation by State and Federal agencies.

Publications

Bulk Milk Handling Costs, Farm-to-Plant. Donald B. Agnew. Seventh Southwest Milk Marketing Conference, Okla. A&M College, May 17-18, 1956 8 p. (proc.).

Farm-to-Plant Bulk Milk Handling Costs. Donald B. Agnew. USDA Agr. Marketing, Vol. 1, No. 2, pp. 6-7, Aug.-Sept. 1956.

15. Bulk Handling of Milk From Farms

FCS

The shift from cans to bulk methods of transporting milk is currently affecting operations of substantial numbers of dairy producers and marketing agencies. Information relative to the problems associated with the change is needed. A national survey completed during the early part of 1956 indicated that the number of producers using bulk methods had increased approximately 200 percent in two years. Bulk methods were being established to varying degrees in all important fluid milk markets and in many smaller markets.

Study of hauling costs indicated that potential economies of bulk hauling are largely dependent on the extent to which bulk haulers procure more than one load a day and provide every-other-day pickup service for each farm. Work on the plant receiving cost phase of this project is just getting underway. This analysis is devised to provide receiving cost data in comparable plants before, during, and after their conversion from can to bulk receipts.

Plans

Work on this project will consist primarily of collecting, analyzing and summarizing plant receiving room cost data. The survey to measure expansion of use of bulk methods may be duplicated in late 1957 or early 1958.

Publications

Farm-to-Plant Bulk and Can Milk Hauling Costs. J. M. Cowden. FCS Service Report 18, March 1956.

Bulk Milk Handling in 1955. J. M. Cowden. FCS General Report 22, April 1956.

Farm-to-Plant Bulk Milk Triples. J. M. Cowden. News for Farmer Coops., May 1956.

Bulk Milk Handling Sets Up a Challenge. J. M. Cowden. News for Farmer Coops., June 1956.

Comparing Bulk and Can Milk Hauling Costs. J. M. Cowden. FCS Circular 14, June 1956.

16. Merchandising Fluid Milk

FCS

Dairy cooperatives are vitally interested in expanding the consumption of fluid milk in order to increase net returns to producers. One phase of this study was to assist dairy cooperatives and other enterprises in deciding whether to engage in vending and to develop guides and standards that would help them in planning and operating sound vending programs where conditions appeared favorable for success.

A national survey of vending machine operators was completed. Questionnaires were received from nearly two hundred operators giving information on break-even points, average daily sales, size and combination of units vended, prices, and other facts relating to their milk vending operations. Most operators replying to questionnaires intend to purchase additional machines, thus implying that they have been satisfied with vending. It was concluded that the basic essentials for success are: (a) Good locations, (b) sound vending practices, and (c) minimum operating costs.

Plans

Work under the first phase of this project will be completed by publication of findings. Another phase of this study, to be undertaken early in 1957, will determine the net effects on marketing costs and consumption of fluid milk of multi-quart containers, and develop guides to help cooperative managements and other milk distributors decide whether or under what conditions to use such containers.

Publications

What About Milk Vending Machines? Hughes H. Spurlock. News for Farmer Coops., Sept. 1956.

17. Diversification of Dairy Processing Facilities

FCS

The economic limits for diversification of dairy processing facilities have never been adequately defined. As the industry is characterized by fewer but larger plants each year, decisions on diversification become increasingly important. The first phase of this project is concerned with a problem confronting managements of dairy manufacturing organizations: Should facilities be added to handle Grade "A" milk? Managers and other key personnel of twelve dairy cooperatives in the North Central region were interviewed. Information was obtained on the basic problems of dairy manufacturing cooperatives with both Grade "A" and manufacturing-grade milk.

Plans

A mail questionnaire will be sent to all dairy manufacturing cooperatives in Iowa, Minnesota and Wisconsin that bottle milk. The data will be analyzed statistically to determine interrelationships and characteristic frequency units. Case studies will be made of dairy cooperatives marketing both Grade "A" and non-Grade "A" milk.

When the current phase is completed, a new phase of the problem of diversification will be analyzed and appraised.

18. Butterfat Sampling and Testing

FCS

Milk is paid for on the basis of its weight and butterfat content. Many problems must be overcome in determining accurately the butterfat content in order that both buyer and seller may be treated equitably. In order to meet the needs of testers, and others vitally concerned with butterfat sampling and testing programs who are not technically trained, a specially designed circular was prepared and issued.

Plans

This project was discontinued in January 1956.

Publications

Selecting A Program for Butterfat Sampling. H. J. Preston.
FCS Circular 11, March 1956.

19. Efficiency in Milk Distribution

FCS

Many farmers, particularly those in southeastern States, have sought during recent years to increase their incomes, and to increase the efficiency of milk distribution, by establishing cooperative businesses which they own and operate.

One phase of this study was to assist fluid milk marketing cooperatives develop more comprehensive and more effective sales programs. A publication tells how to develop a sales program by measuring market sales potential, pricing realistically, promoting intelligently, and advertising effectively; how to merchandise efficiently by packaging attractively, delivering to homes, selling through stores, obtaining and holding customers, and making milk more available; how to develop sales personnel by organizing the sales staff, training routemen, and providing incentives to routemen; and how to build good public relations.

A second phase of this study is to assist milk distributing cooperatives to measure and increase efficiency on their milk delivery route. Information bearing on efficiency of milk delivery routes -- such as methods used to measure efficiency -- has been assembled. A publication is being prepared to assist cooperative managements to determine what information is needed, and how it can be obtained and used, to measure efficiency and to develop methods of increasing efficiency in delivering milk in the conventional manner.

Plans

Study of efficiency on milk delivery routes will be completed in 1957. Another problem area of efficiency in milk distribution will be studied.

Publications

Selling Milk ... Ideas for Cooperative Managements. Donald E. Hirsch. FCS Gen. Rpt. 20, October 1955.

Score a Bull's Eye with Better Dairy Co-ops. Donald E. Hirsch. News for Farmer Coops., Jan. 1956.

What's Your "Break-Even Point" in Milk Distribution? Donald E. Hirsch. News for Farmer Coops., April 1956.

Locating a Milk Distributing Plant. Donald E. Hirsch. News for Farmer Coops., July 1956.

B. PRICES

1. Marketing and Pricing of Surplus Milk

AMS-OC

A continuing project in studying the handling and pricing of surplus milk in the South Central area (Okla., Kans. and bordering areas of Mo. and Ark.). Completed phases of this project cover prices paid producers for surplus milk and marketing outlets for products processed from such milk; the current phase covers market organization and structure; projected phases will include distributor response to price changes and marketing margins.

In the northeastern regional project aimed at obtaining more efficient utilization of surplus milk in the Northeast, data have been collected for individual plants in four primary markets, and for secondary markets in seven States. Data have been summarized for the region, for States in the area, and for individual markets. These data have been analyzed, and a manuscript is being prepared which will afford detailed utilization information for the area, along with information on circumstances affecting utilization.

The North Central regional project is studying the methods of handling surplus milk in selected markets in order to find how it may be handled most advantageously for producers. Particular attention is being given to distress supplies. Nearly every market of 25,000 population or over in the region has been covered in a preliminary survey.

2. Operation of Classified Price Plans in Fluid Milk Markets

AMS-OC

A study dealing with the theoretical aspects of milk classification and its effects on producers, consumers, and distributors has been completed. A report has been circulated among a few economists to gain the benefit of their comments prior to its editing for publication. The report extends the theory developed by economists and

relates it more precisely to the actual conditions of competition existing in our city milk markets. Findings from this report should provide an improved basis for evaluating the policies of and practical decisions made by industry groups and government agencies with respect to the pricing of milk in fluid milk markets.

3. Allocation of Products Among Milk Classes

AMS-OC

Data on experience with use classification in Federal order markets have been tabulated to show changes that occurred between 1936 and 1954 in the number of use classes and in the allocation of milk products among the various classes. Reasons for the changes are being analyzed in order to obtain an indication of the direction and extent of changes in classification that might be expected as solutions to pricing problems in major fluid milk markets, and to determine the bases upon which new milk products should be classified. A manuscript is now being prepared.

4. Central Market Pricing

AMS-OC

A study of short-time price changes in the Chicago butter market has been completed and there is now ready for clearance the first draft of a report, "Analysis of Short-Time Changes in the Price of Butter at Chicago."

The current report examines the nature of day-to-day and week-to-week fluctuations in butter prices at Chicago during 1947, 1948, 1951, and the first quarter of 1952, and analyzes the extent to which such variations can be related to, or explained by, short-time changes in selected supply-demand factors, for 10 marketing seasons encompassing a total of 811 trading days.

5. Pricing Fluid Milk

FCS

Production of fluid milk in most markets varies seasonally much more than consumption. The first phase of this study was to assist milk marketing cooperatives in developing effective informational programs to encourage producers to provide seasonally more uniform milk supplies. Data collected previously were analyzed. Progress reports were prepared and issued, and the final report is completed. It was concluded that cooperatives can obtain a comparatively uniform seasonal pattern of milk deliveries by providing price incentives and a well-balanced educational program. Such a program must be long-term and so thorough that members will make changes in herd management practices.

A second phase is concerned with development of effective pricing methods to reduce the seasonal variation of production of fluid milk. The purpose of the study is to assist milk marketing cooperatives develop effective seasonal pricing plans for milk by presenting basic essentials, advantages, and limitations of each kind of plan in use.

A reasonably complete reference report will be prepared on all types of seasonal pricing plans. Data have been compiled on seasonal pricing practices in most city markets.

Plans

Work on analysis of educational programs was discontinued in Sept. 1956.

In the second phase -- analysis of seasonal pricing plans. -- information not available from published sources will be obtained in the field. A report will be prepared for publication which will discuss major provisions of each type of price plan, advantages and limitations, and special problems.

A third phase, concerned with pooling, will be initiated in 1957 or 1958. Price levels for milk, transportation costs, and seasonal price plans have changed since the most recent detailed study of pooling plans was reported in 1938.

Publications

Meeting Seasonal Problem of Dairy Cooperatives Through Education. Stanley F. Krause. FCS. Bul. 9, June 1956.

Educating for More Even Milk Deliveries. Stanley F. Krause. News for Farmer Coops., Oct. 1956.

Dairymen's Response to Seasonality Information. Stanley F. Krause. News for Farmer Coops., Dec. 1956.

C. SUPPLY AND CONSUMPTION

1. Identify and Measure the Economic Factors that Affect the Price and Consumption of Milk and Dairy Products AMS-AEc

This study measured the extent to which consumers alter their consumption pattern of dairy products following changes in prices, income and other economic factors and studied the influences that affect prices of dairy products. Findings indicate that consumers' response to price changes for butter increased during the early postwar years when the shift from butter to margarine was taking place as compared to consumers' reaction to price in the period prior to World War II. However, indications are that consumers in the last few years and currently probably react to price in about the same way as they did in the prewar period. For example, for each 10 percent decrease in price, consumers tend to increase their purchases of butter by 6 to 8 percent, assuming no change in income and price of margarine.

Certain items not originally scheduled for inclusion in this study, such as studies of normal seasonal variation in prices and consumption of dairy products and data on Government support programs for dairy products were added. It is believed that the several changes will result in a more effective and better rounded study.

Results of this study have numerous uses including appraisal of effect on consumption of changes in retail prices, effect on prices, utilization of milk and farm income of changes in demand for dairy products and effect on utilization of milk and farm income of changes in price-support levels.

Plans

Research has been completed and a draft of a technical bulletin is in process of review. Copies should be available sometime during 1957.

2. Identify and Measure the Economic Factors that Affect the Production, Price and Utilization of Milk AMS-AEc

The main areas of work covered are: (a) Measurement of economic influences that affect milk production within relatively short periods of time, such as a year; (b) measurement of economic influences that affect long-range plans of farmers as reflected in the number of cows and replacement heifers they keep for milk and (c) integration of results from both supply and demand analyses to study longer-run trends in production and utilization of milk and the supply-consumption balance. Analyses have been confined to the first two lines of investigation.

In the study of economic factors that affect milk production during the short-run, special emphasis is being given to use of statistical methods which separate out the influences of factors which affect simultaneously both the supply of and demand for milk. Some analyses of factors affecting the number of cows kept for milk have been completed for the United States as a whole and for several individual States. Factors considered were prices of milk and butterfat, prices of beef cattle and hogs, number of replacement heifers, supplies of hay and a production index to reflect improved quality of milk cows. Preliminary results indicate that, in any given year, changes in the number of replacements available and certain longer-run factors explain a larger percentage of the variation in cow numbers than do prices of milk and prices of products of alternative farm enterprises.

Plans

Work will be continued.

D. EVALUATION AND MAINTENANCE OF PRODUCT QUALITY

1. Superheating Treatment to Improve Nonfat Dry Milk for Baking AMS-BS

This research was to investigate optimum conditions of superheating concentrated skim milk to obtain improved baking quality of nonfat dry milk powder. Apparently heating milk in the concentrated state alters the proteins in some manner which allows them to absorb increased amounts of water. This property is retained in the dried milk and provides a more desirable product for baking purposes. A series of superheating treatments were carried out to obtain increased water absorption, and the resulting powders were tested for baking quality. Many of the superheating treatments did not result in increased water absorption of the nonfat dry milk, unless the superheating produced increased viscosity as a result of protein destabilization. At 40% solids concentration and a superheating treatment at 180°F for 10 minutes, a non-fat dry milk was produced which allowed a water absorption 50% over the normal value; satisfactory bread was produced with slight modification in regular bread manufacturing procedure.

Plans

Additional studies of the precise relationship between dough mixing time and water absorption as well as possibilities of altering protein stability through salt balance rearrangement to produce improved baking quality in nonfat dry milk will be made.

2. Test for Determining Baking Quality of Milk Solids AMS-BS

In studies on the possibility of using enzyme activity as a measure of suitability of dried milk for baking use, it was established with accurate assay techniques that the enzyme xanthine oxidase was inactivated at too low a temperature to be of practical value.

A chemical test has been designed which correlates well with the accepted Harlan-Ashworth test for measuring soluble whey nitrogen in non-fat dry milk. The new test is much simpler and faster.

Plans

Attempts to apply enzyme tests as a measure of the suitability of non-fat dry milk for baking use have been discontinued.

The chemical test for a similar purpose will be studied further.

3. Insects and Mites Attacking Dairy Products AMS-BS

In this project (coop. Wis. Agr. Expt. Sta.) the biology of cheese mites and Trogoderma versicolor, a pest of dried milk, was studied, and various modern residual insecticides evaluated in the laboratory. A second phase, practical field tests under industry conditions, is being started.

Further tests were made on the effectiveness of insecticides at a lower temperature level, 33-35° F. Lindane and Diazinon were still the most effective materials at this temperature level, as they had been at 55° and 45° in earlier tests. Other materials that showed promise at the higher temperatures were much less effective at 33-35°.

No individuals of Trogoderma versicolor or the black carpet beetle penetrated or invaded drums of non-fat dry milk packed in the conventional manner with a double liner of kraft paper and polyethylene, and a kraft sealer, when a number of drums were stored for 7 months in heated warehouse rooms well infested with one or the other species. In the same test, insects were found between the kraft and polyethylene liners in wooden barrels packed in the conventional manner, but not in the dried milk. Where no liners were used, insects were found in the milk in both drums and barrels. When insects were planted in the drums, or between the liners, or in the dried milk, both species readily penetrated the kraft liners, but only the black carpet beetle penetrated the polyethylene liners to any extent.

Plans

It is planned to further expand the studies.

4. Nutritive Value of Different U.S. Grades of Hay

AMS-BS

The results of the 1954-55 feeding trial (coop. DH) demonstrated a significant difference in feeding value between 3 lots of U.S. No. 2 alfalfa hay and 3 lots of U.S. No. 2 alfalfa light timothy mixed hay with a timothy content of 13-28%. The difference between classes was confounded by a highly significant difference between lots within the alfalfa light timothy mixed class. This indicated the need for additional comparative data for the two classes.

Accordingly three lots of each class at the No. 2 grade level were purchased and fed to dairy heifers for a 150-day feeding period. Two lots of each class were within the class specifications on the basis of subsequent sampling, timothy content of the light timothy lots being 7% and 21%. The daily live weight gain data from the 1955-56 experiment were analyzed separately and combined with the similar data from the 1954-55 experiment. Both the single year data and the combined data showed that the differences between classes were not significantly greater than the differences between lots within classes. The major portion of differences within class being associated with the alfalfa light timothy mixed class.

It was concluded, that at the No. 2 grade level, the present 5% limit on timothy in the class alfalfa could be increased only a small amount, perhaps to 10%, without introducing objectionable variations in feeding value. Data on additional hay lots in this 5-10% timothy range would be needed prior to any conclusions in regard to this possibility.

Plans

No further investigations are planned. The project was terminated June 30, 1956.

E. MARKET ORGANIZATION

1. Milk Procurement Practices and Policies

AMS-OC

Procurement practices of a group of milk companies in Northwestern Wisconsin were studied intensively in 1953 and 1954 (contract Uni. Wis.). The study is now completed. One bulletin has been published and a second manuscript is in press. Competition among the firms for milk is intense. Large firms tend to compete directly with other large firms and to ignore small companies. But small firms considered the large plants their chief competitors. This competition, however, is based more on nonprice devices than on prices. Most firms attempt to pay producers near the average of prices paid by competitors, especially the largest plants. Fieldmen, haulers, free milk cans, discounts on farm supplies, financing of farm equipment, group life insurance, and favorable personal contacts between farmers and plant personnel are used to persuade farmers that a particular plant is the best place to ship milk. The costs and inefficiencies of this competition are not easily determined and may or may not be detrimental to farmers. Some of the "free" services to farmers seem to be valued highly by them.

Publications

Procurement Policies and Practices of a Selected Group of Dairy Processing Firms, Part I. Some Aspects of Market Structure, Competitive Behavior, and Market Results. R. L. Clodius, D. F. Fienup, and R. L. Kristjanson. Wis. Agr. Expt. Sta. Res. bul. 193, Jan. 1956.

2. Marketing Northeastern Livestock With Emphasis on Dairy Animals

AMS-OC

In this Northeastern Regional Livestock Marketing Research project surveys have been made to obtain descriptions of the channels of marketing, the methods and practices of marketing agencies, and the adequacy of livestock market outlets with a special emphasis on marketing of discarded dairy animals, both cows and veal calves. A manuscript on the auction market phase of the work has been submitted for publication as Northeast Regional Publication. A preliminary manuscript also has been prepared on the dealer operations. Analysis is under way on purchases, sales and marketing practices of producers.

Plans

An additional manuscript on the phase of livestock marketing by producers will be developed. A survey of packing house operations in the Northeastern area also will be undertaken.

3. Adjustment to Changing Demand and Supply of Milk in the South AMS-OC

A study to determine the demand for milk and milk products in the South and desirable adjustments for changes in demand has been instituted. Data on consumption and price of fluid whole milk, buttermilk, skim milk and evaporated and powdered milk have been collected for 12 Southern cities. The analysis relating to fluid milk has been completed and a preliminary manuscript prepared covering the effect of price, income, and race on the demand for fluid milk and milk substitutes.

Individual States are analyzing data for their cities on an intra-market basis for extension use or State reports. A regional report is being completed on the position of dairying in the South, utilizing secondary information to show the changing status of the dairy industry in the region.

Plans

It is expected that these manuscripts will be completed for publication in 1957.

4. Milk Control Agencies in the Northeast

AMS-OC

A final report has been published in the study of State milk control agencies in the Northeast. This report analyzes the administrative and legal aspects of State milk control programs in the Northeast, the services provided under these programs, and the coordination among State milk control programs, and between them and the Federal market orders.

The report indicates advantages for administration by a single director, with an active advisory committee, condemns restrictive licensing, and points out the need for more effective education and enforcement by State milk control agencies. Recommendations are made for distinguishing between situations requiring State, joint Federal-State and Federal milk regulation.

Publications

Milk Control Programs of the Northeastern States, Part 2, Administrative and Legal Aspects and Coordination of State and Federal Regulation. Leland Spencer and S. Kent Christensen. Northeast Regional Pub. No. 23, Cornell Agr. Expt. Sta. Bul. 918, Nov. 1955.

5. Marketing Organization and Practices for Mellorine

AMS-OC

Returns from a mail survey of 442 plants which make or have made mellorine are being summarized (contract Uni. of Kansas). About 1 out of 4 plants responded. Based in part on leads given by this

summary, several market areas will be selected for intensive study in the final phase of this project.

6. Store Distribution of Milk in Small Towns

AMS-OC

This project, a sequel to the North Central regional study of outer-market distribution of milk, has reached manuscript stage. Covering 235 stores in 27 counties of Ken., Ill., and Mo., the report presents information about the fluid milk products handled, characteristics of delivery and other services provided by milk distributors, store margins and profits, and promotion of dairy products.

7. Economic Adjustments in the Dairy Industry

AMS-OC

Work has continued on the analyses of creamery costs, cream marketing and pricing practices, and cream quality. This is a part of the North Central regional project dealing with dairy marketing adjustments in the Northern Plains States.

F. MARKET DEVELOPMENT

1. Household Purchases of Butter, Fluid Whole Milk, and Fluid Skim Milk

AMS-MD

This is a continuation of the work (coop. Amer. Dairy Assn.) started in April 1954 on household purchases of butter, cheese, nonfat dry milk solids, and margarine. The coverage was changed in April 1956 to include butter, fluid whole milk, and fluid skim milk; at that time the reporting on cheese, nonfat dry milk solids, and margarine was discontinued. The data are being obtained from the National Consumer Panel of the Market Research Corporation of America.

The monthly data obtained under this project are providing current estimates on rates of movement and related factors for the selected dairy products; the quarterly data give detailed quantitative information on regional purchase rates by householders and shifts taking place through the various retail outlets; and the family characteristics data covering a 6-month period each year show consumption patterns and changes for households in the many categories surveyed.

Results of this work have provided producers with a better understanding of their market. The dairy industry is using these data in their sales efforts. Furthermore, information from this survey is used by the Department in appraising the effectiveness of its programs. Other interested parties such as home economists and nutritionists are appraising the data in light of dietary needs of various population segments on a regional and national basis.

Plans

Plans to continue the purchase of these data after March 1957 are not firm.

Publications

Household Purchases of Butter, Cheese, Nonfat Dry Milk Solids, and Margarine. Monthly, quarterly, and annual.

Household Purchases of Butter, Fluid Whole Milk and Fluid Skim Milk. Monthly, quarterly, and annual.

2. Availability of Milk Through Retail Vending Machines

AMS-MD

A study (coop. W. Va. Agr. Expt. Sta.) has been underway in Berkeley County, West Virginia, to determine the net effects of sales of milk through vending machines. The American Dairy Association, dairy distributors in the area, and manufacturers of vending machines aided in the development of this work.

Data are now being collected and tabulated on sales of milk through vending machines and on total sales of milk by dealers in the experimental area. Intensive efforts are also being made to estimate population changes in the area so as to evaluate results on a per capita basis. There are no preliminary findings from this study at this time.

Plans

To continue the collection of data through June 1957 and to publish a report in fiscal year 1958.

3. Evaluation of Selected Retail Advertising Practices on Sales of Butter

AMS-MD

The purpose of this research, conducted in St. Louis, Mo., from January 16 through April 7, 1956, by means of a controlled retail store experiment, was to measure the extent of the effect that specific in-store promotions of butter might have on the retail sales of the product, and also, to determine which of two approaches to advertising butter within retail stores would be most effective. The two approaches were: (1) In-store promotion of butter, with two slogans "Better Buy Butter" and "Better with Butter;" and (2) an overall promotion of dairy products, with some specific mention of butter, but employing the theme "Dairy Foods Festival." The results of this work are currently being prepared for publication.

4. Effect of Selected Retail Merchandising Practices on Sales of Butter

AMS-MD

A butter merchandising experiment was conducted during a 16-week period in 14 retail stores in Cleveland, Ohio, to determine the effect of alternative methods of merchandising on retail sales of butter. The factors tested were: (1) Location of butter in the dairy case; (2) size of butter display; and (3) type of butter carton--pictorial vs. nonpictorial. Results of this study indicated that while there

were differences in sales volumes under different methods of merchandising, none of the observed differences were statistically significant.

Publications

Effect of Specific Merchandising Practices on Retail Sales of Butter. H. J. Huelskamp, W. S. Hoofnagle, and M. Myers. USDA Marketing Res. Rpt. No. 117, May 1956.

5. Evaluation of Merchandising Practices on Retail Sales of Cheese AMS-MD

This study was designed to test and evaluate the effect of: (1) Package size; (2) type of display; and (3) type of package (in-store vs. pre-package) in a sample of 12 retail food stores in Pittsburgh, Pa. Mild and sharp natural cheddar cheese were the types used in the experiment.

Results of this study indicated that: (1) More cheese is sold in total when consumers are offered the choice of both in-store and pre-packaged cheese; (2) weights of cheese up to 2 pounds resulted in larger sales than weights up to 1 pound only; and (3) formal or jumble displays did not effect sales of cheese.

Publications

Merchandising Natural Cheddar Cheese in Retail Food Stores. H. M. Smith, W. E. Clement, and W. S. Hoofnagle. USDA Marketing Res. Rpt. No. 115, April 1956.

6. Evaluation of the Effect of Coupons and "Special Offers" on the Sales of Food Fats and Oils at the Retail Level AMS-MD

Consumer purchase data from a sample of 500 panel families in Chicago are being studied to ascertain the effects of coupons and "special offers" on the volume of sales of food fats and oils, including butter, at the retail level. The consumer panel data cover the period July 1, 1953, through June 30, 1955. These data include details on family purchases of each of the four products--butter, margarine, shortening, and cooking oils--by date of purchase, brand purchased, quantity purchased, price paid, and whether any coupons or "special offers" were involved in the transaction.

Plans

The analysis of the data has begun, and it is anticipated that a report will be available the latter part of fiscal year 1957.

7. Marketing Practices and Channels Used by Industrial Feeding Facilities in Purchasing Food

AMS-OC

This study (coop. MD) is designed to measure the amounts and kinds of foods absorbed by food facilities provided for employees by industrial plants, and to learn management evaluations of the usefulness and importance of these food facilities. Data were collected on where these facilities buy food, how they buy, how much and what kinds of food they use. The results will be presented in separate reports by commodity types. Data were collected during January and February 1956 by a private market research company under contract.

Plans

Preliminary reports will be available in 1957.

8. Consumer Preferences for White Pan Bread

AMS-MD

Some of the major findings of this research are: (a) Increasing specific volume from 7 to 10 cubic inches per ounce resulted in a significant increase in preference for the bread; (b) increasing the sucrose content from 2 to 7 percent resulted in a significant increase in preference; (c) inclusion of 4 percent of nonfat milk solids increased the preference for the bread significantly as compared with bread having no milk solids; a further increase in content to 8 percent did not have a significant effect; and (d) Increasing the lard content from 3 to 5 percent did not significantly affect preference.

Publications

Consumers' Preferences Among Bakers' White Breads of Different Formulas, A Survey in Rockford, Ill. Hugh P. Bell. Marketing Res. Rpt. No. 118, May 1956.

AMS-AEc

9. 1955 Household Food Consumption Survey

AMS-MD

ARS-HHE

This is the first nationwide study of food consumption since 1942 that covers rural as well as urban households.

The preliminary tables from this survey indicate that food expenditures of housekeeping families in the U. S. averaged \$27 a week in the spring of 1955. About \$22 of this was for food consumed at home. The remainder, \$5, was spent for meals and between-meal food away from home. With average size of the household at 3.43 persons, average expenditure per person amounted to \$7.89 a week for all food. Of this, \$6.50 was spent for food to be prepared at home, and \$1.39 for food consumed away from home. The tables also make possible comparison of rural and urban regional, and income groups as to family food expenditures.

The food expenditure increase since the previous nationwide survey in 1942 indicates the effect of both higher food prices and the use of more expensive foods. In 1955, average food expenditure was about three times the average of \$10 in 1942. A more precise comparison can be made for urban families of two or more persons. They spent \$13 in 1942, \$26 in 1948, and \$32 in 1955. Retail food prices as measured by the Bureau of Labor Statistics index advanced only 6.5 percent between 1948 and 1955. The fact that family food expenditures increased about 25 percent indicates what is sometimes referred to as "up-grading" of the diet--either use of more expensive types of foods or inclusion of more services, such as precooking of foods, in the foods purchased.

Plans

Five sets of initial reports are to be prepared and all are to be included in one Department publication series. Plans have been made for first releases in this series beginning late in 1956. In all reports, separate data will be shown for each region and the U. S. by income groups for rural farm, rural nonfarm, urban, nonfarm (rural nonfarm and urban), and all urbanizations combined. In the processing of these data, the work has been planned to make the listings, punch cards, and tapes as useful as possible for later research.

With respect to dairy products, as much detail as possible will be shown for households in each region, urbanization and income group. Consumption of milk and manufactured dairy products will be totaled in terms of calcium content as well as in terms of nonfat milk solids and milk fat. Product detail shown will include the various forms of fresh fluid milk, processed milk, cream, ice cream, butter, and cheese. The reports on dietary levels will show the contribution of milk products to the total amounts of the various nutrients in family food supplies.

10. Elasticities of Demand with Respect to Income for Major Food Groups

AMS-MD

Work is in progress on determining the relationship between consumption and income of major foods and groups of foods, including milk and the principal dairy products. This study is based on individual family observations from the Survey of Household Food Consumption. Household size as well as income is being taken into account in measuring the relationships. It is expected that this information will be useful to market analysts and others investigating patterns of food consumption for the purpose of devising programs for promoting consumption of certain food products, and as an aid to legislators in developing programs for subsidized consumption among low income families of agricultural products in surplus supply. A contract has been let with a private firm for performing statistical computations.

Plans

A report will be published this fiscal year.

11. School Lunch Program Evaluations

AMS-MD

A study relating to feeding programs in elementary and secondary schools throughout the nation is being initiated. It will be the objective of this study to determine: (a) The extent of school feeding programs in the United States and student participation therein; and (b) reasons for participation and non-participation of schools and children in the National School Lunch Program. A part of the inquiry will relate to milk in school feeding programs. This will provide regional and national figures on school milk consumption.

Plans

Collection of data for this study will begin early in 1957 and results will be published later in the year.

12. School Milk Program Evaluations

AMS-MD

Studies are currently underway in St. Louis and Los Angeles to determine and evaluate the effects of certain factors on milk consumption in elementary schools and high schools. The factors being studied include price, availability, size of serving units, income and educational level of parents, size of school, grade level of students, and the availability of chocolate drink.

Preliminary findings show milk consumption in St. Louis elementary schools with lunchrooms to be up by 200 percent during September-November 1955 compared with a year earlier (exclusive of milk served with Type A lunches). This increase was associated with a 50 percent reduction in price made possible by the Special School Milk Program and additional times of service in most schools. In elementary schools with milk stations the increase in milk consumption during these months was 125 percent while the price was down 50 percent.

In Los Angeles city schools milk consumption was up 110 percent in September-November 1955 when the price was reduced 21 percent in elementary schools and 53 percent in high schools accompanied by the introduction of larger size containers.

Plans

Reports of these studies will be published during fiscal 1957.

PROPOSALS
for
COMMITTEE CONSIDERATION

III. MARKETING

1. Control of Insects and Mites Attacking Dairy Products

Further expand the research on control of insects and mites attacking cheese and nonfat dry milk, particularly in relation to studies under practical plant and warehouse conditions to evaluate the degree of control and the freedom from undesirable insecticidal residues, and of material and methods giving best results in laboratory testing.

2. Measuring the Market Quality of Nonfat Dry Milk

Expand research on the development of appropriate tests for the market quality of milk solids. Present quality standards for this product do not always reflect its value in terms of end use, largely because of the lack of rapid test methods for certain quality factors. Better tests are needed for evaluating the suitability of milk solids for breadmaking and for detection of harmful enterotoxine. Such tests have been proposed in the past, but their lack of general acceptance indicates that further work should be conducted to develop satisfactory methods.

3. Consumer Panel in a Large Metropolitan Area

Initiate a consumer panel in a large metropolitan area to obtain data for continuous and comprehensive evaluation of food product advertising, promotional programs, merchandising innovations, and new product introductions on a large commercial scale. The data would yield detailed household food purchase records which would supplement national and regional studies of the consumption habits and attitudes toward food and nutrition in relation to family income and other characteristics. Data obtained through the panel would also provide numerous by-product benefits in the form of comprehensive information on the trends in use of new forms of foods and food services, such as frozen and concentrated foods and food packaging.

The consumer panel would provide continuous basic market information on a number of dairy products. The cost of obtaining this comprehensive data on dairy products would be lower in a consumer panel operation through which all foods are reported weekly than would be the case under present techniques.

4. Consumer Use of Nonfat Dry Milk vs. Evaporated Milk

Initiate a study to determine the effect of the home use of nonfat dry milk on consumption of fluid milk and evaporated milk, so as to

ascertain the degree of substitution or supplementation among these products. The data will be obtained from an existing consumer panel, in order to assess changes for each family participating from 1953 to 1956. It is proposed that the purchase data be aggregated and analyzed on the basis of income and other family characteristics.

The information obtained under this study would provide the dairy industry with some answers as to the overall effect of the recent increase in home use of nonfat dry milk on fluid and evaporated milk. In addition, the data would enable the industry to ascertain whether these changes have more impact among various population segments than others.

5. Market Testing New and Improved Dairy Products

Initiate work to measure market demand and consumer acceptance for new and improved dairy products. Such work will include auditing sales of new dairy products and closely competing products from a sample of retail stores and consumer surveys in the test market to determine, among other things (a) volume of sales of new dairy test products, (b) amount of sales in relation to competing products, (c) the effects of advertising, (d) the proportion of homemakers buying the product(s) and the rate of repeat purchases, (e) the reaction of consumers to the product(s) and whether the sales of the new product(s) are a net addition to the consumption of dairy products or only replacing the demand for existing dairy products.

6. Market Potential for Cultured Sour Cream

Initiate research to determine the possibilities that cultured sour cream offer for expanding consumption of butterfat. By using market testing techniques, information should be developed as to what may be expected from greater and widespread sales efforts for this product. Emphasis will be placed on work in low-consuming areas. There have been some indications that cultured sour cream has possibilities for moving more butterfat to consumers. In addition, new uses for sour cream in recipes, as a salad dressing, etc., have been developed.

7. Away-From-Home Eating

Explore the desirability of cooperating in or making large-scale studies of major categories of away-from-home food operations.

A substantial part of U. S. food consumption takes place outside of family households, but relatively little information is available on the consumption patterns and marketing practices of this segment of the total food market. Work in this field should emphasize the types and qualities of foods purchased by such eating places and their role as a market outlet for foods. In the past 10 years the Department of Agriculture has made pilot studies (a) of eating places in Minneapolis

and Fairmont, Minnesota; (b) of 15 selected penal, old-age, mental, children's institutions; (c) of usage of frozen foods by restaurants; and (d) a nationwide survey in 1956 of employee feeding operations of manufacturing plants. Because of the growing interest in this area, consideration is being given to the formulation of specific proposals for research in several segments of the away-from-home food market both in cooperation with industry groups and unilaterally. Because this market includes all foods and a great variety of organizations, it is so broad and complex that reasonably adequate coverage will probably require the combined efforts of public and private research agencies over a period of several years. Selection and timing of research projects must be meshed with research plans of other agencies.

8. Butter Price and Quality

Initiate studies to improve the relationship between butter quality and price. Quality problems are more urgent in the case of butter than for any other dairy product. Differences in quality of butter appear to be poorly correlated with differences in price, particularly at the creamery level. Studies are needed to show the types of uses or markets to which butter of various characteristics moves, the extent to which flavor is a sorting factor in printing and distribution, and the price differentials existing among qualities at different levels of trading.

9. Pricing Methods

Expand work on the pricing of dairy products, including prices set by regulation and those set by market forces. Transactions in which prices are not regulated are important guides to farmers; and marketing agencies' choice of markets. Analyzing the factors affecting these prices, the nature of the transactions, and the responses to prices will lead to a wiser use of reported market price information. Regulatory agencies need more information about the price structures they administer.

10. Marketing Costs and Efficiency

Expand studies describing and analyzing the costs of providing marketing services, and developing more efficient marketing methods. There is a twofold need for more comprehensive information about marketing costs: The public concern over marketing costs as an element in the price of food; and the need for greater efficiency to maintain profits and reasonable unit costs in the face of rising wages and prices of materials used in marketing.

11. Market Structure and Practices

Expand studies of the adjustments being made by producers and marketing firms to new market situations. Changes in production, consumption and methods of processing and distribution from year to year make some established methods obsolete. Supply and distribution areas are growing, size and form of marketing firms are changing, and new methods of handling, transporting, packaging and selling are appearing. Adjustments to these changes may be made more easily if their requirements and implications are carefully studied and made known.

12. Improved Work Methods, Equipment and Facilities for Fluid Milk Plants

Expand the research to develop improved work methods, equipment, and facilities for fluid milk plants. This work should be extended to one of the North Central States. The research should cover: (a) The evaluation of present work methods and equipment, (b) the development and testing of improved methods and equipment, and (c) the design of improved facilities.

13. Cheaper or Improved Containers for Fluid Milk

Expand research on consumer packaging of fluid milk and cream to develop and evaluate cheaper and more efficient types and sizes of packages, new types of packaging materials which are constantly being introduced, and improved and more efficient methods of packaging.

IV. MARKETING SERVICE AND EDUCATION

A. MARKETING SERVICE

1. Outlook and Situation Analyses

AMS-AEc

Analyses of the past year were focused on the following aspects of the statistical and economic position of the dairy industry: Recent changes in consumption of dairy products following changes in retail prices and consumer incomes; projected alternative consumption (and production) levels for the year 1975., assuming certain per capita use rates; trends in size and number of dairy farms; changes in annual and seasonal rates of grain feeding to milk cows; and comparison of Class I (fluid milk) prices with blend prices for the past decade for a number of specific marketing areas.

The appraisal of price and income effects on consumption rates was based on the quantities of each item obtained from strictly commercial sources, as opposed to including quantities flowing through "Government assisted" channels. The latter includes distribution to school children, to welfare organizations, needy persons, and other eligible domestic outlets. Exclusion of these quantities indicated little increase in consumption per person of dairy products, 1953 to 1955, suggesting that there may have been a further decline in consumer demand in that period.

The discussion of the "Role of Federal and State Governments in Pricing Fluid Milk," prepared in cooperation with other Divisions for a special feature in the Dairy Situation, again proved popular in view of complexity of fluid milk pricing. The comparison of Class I and blend prices indicated a widening of differential for recent years associated with relatively larger increase in milk production than in fluid milk consumption.

Plans

Efforts will be made to improve methods for gauging current consumption rates for dairy products as a basis for appraising any changes in consumer demand. More attention will be given to regional analyses in developing situation and outlook materials. Milk production trends will continue to be observed closely to ascertain effects of changed price relationships or programs, as a basis for both administrative and published reports. To develop a comprehensive handbook of dairy statistics to improve upon the document "Dairy Statistics and Related Series."

Publications

Six issues of the Dairy Situation were published and the third edition of "Dairy Statistics and Related Series" were released. A number of special articles dealing with timely current developments were prepared for other releases.

2. Current Monthly Estimates of the Production of Ice Milk and Low-Fat Frozen Dairy Products and Cottage Cheese

AMS-AEs

Steps are being taken so that the first report of current monthly estimates of the production of ice milk and other low-fat frozen dairy products and of cottage cheese for January 1957 is scheduled to be released in February 1957. This release will also include estimates on the monthly production of cottage cheese, ice milk, and other low-fat frozen dairy products in 1956, since these monthly estimates must be made as a basis for projecting the monthly estimates for 1957 production of cottage cheese and ice milk until the 1956 enumerated figures become available.

3. Statistics on Sales and Consumption of Fluid Milk and Cream

AMS-AEs

Special emphasis during the year was placed upon the continuation of the per capita consumption of fluid milk and cream project. A project was set up for collecting and analyzing all of the material on the receipts and sales of fluid milk and cream for fluid consumption available in the administration of both Federal and State Milk Marketing Orders subsequent to 1945. At the instigation of important groups in the dairy industry, the Census Bureau in 1955 transferred the fluid milk and cream industry from the Division of Distribution to the Manufacturing Division, and in its Census of Manufactures for 1954, obtained for the first time data on the volume of milk and cream handled by milk distributors for fluid consumption as such. After publication of the Census Bureau figures, it is proposed to analyze fully the data for the establishment of another benchmark in estimating the per capita consumption of fluid milk and cream by States. The data accumulated on sales of milk and cream for fluid consumption will be used in estimating the trend, by States, for the intercensal years of 1945 and 1953. It will probably take between 1 and 2 years after the Census data are released to true-up the 1954 benchmark by States and to analyze and set up the intercensal estimates between the 2 benchmarks.

The next Census of Manufacture survey by the Census Bureau will be in 1958, and the problem of setting up a procedure for estimating the intercensal years should be established rather readily. Also, following the 1958 Census, it should be possible to estimate the annual per capita consumption of fluid milk and cream, by States, currently, subject to revision when the quinquennial Census data becomes available.

PROPOSALS
for
COMMITTEE CONSIDERATION

1. Retail and Wholesale Prices of Fluid Milk and Cream

Initiate a study of the sources and methods involved in collecting, tabulating, and publishing fluid milk and cream prices for urban markets in the U. S. During recent years fluid milk markets have experienced many significant changes in types of products sold, types and size of containers used, shifts in sales from home delivery to cash and carry retail stores, and volume price discounts. The increasingly complex price structure has made necessary a larger list of price reporters in the face of increasing reluctance on the part of milk distributing companies to undertake the burden of monthly price reporting.

An attempt has been made to adjust price collecting and reporting procedures to meet these changed conditions by piecemeal revisions in price schedules, tabulations and reporting procedures. The problems of maintaining accurate and complete price reporting are rapidly becoming more difficult to meet and it is apparent that a thorough going review of the entire situation is necessary. Information will be obtained from users of the data in the Fluid Milk and Cream Report as to inadequacies in scope of product and markets covered; degree in which price coverage by retail outlets and package sizes and types is incomplete, and other matters needing attention. Information will be obtained from voluntary price reporters respecting the burden of work involved, limitations on scope and accuracy of prices quoted and reasons for delay or failure to report. It may become necessary to investigate the possibility of devising entirely new reporting sources and procedures.

B. EDUCATION

1. Educational Programs in Marketing

FES

Only a part of the extension work in dairy marketing is financed with Agricultural Marketing Act funds. Twenty States have AMA projects in dairy marketing for fiscal year 1957. This is twice the number in 1953. At that time all but two States with projects were in the Midwest (including Okla. and Ark.). Now there are two additional States in the Northeast, five additional in the Southeast and one additional in the West. Practically all the States with projects now, had limited work, if any, in dairy marketing prior to the development of present projects. Most of the educational work in dairy marketing that was carried on before passage of the Agr. Marketing Act was in the Northeast and the upper lake region.

Active work has started on a project (coop. ARS) designed to disseminate and demonstrate results of recent research in both dairy waste disposal and the short-time process for making Cheddar cheese. The early stages of developing a program have included conferring with research personnel and observing various processes for both the waste disposal and cheese work. Discussions have been held with a number of industry personnel interested in the work. A tour of dairy plants using the new method of dairy waste disposal was made and the fall meeting of the subcommittee on dairy waste of the Dairy Industry Committee was attended.

A program is being developed to work through the land grant colleges in cooperation with the dairy industry to broaden the application of the research from the few plants now in the process of adapting or already using the new methods. It is hoped that cooperation of these pioneering plants can be obtained to provide practical information and to assist in demonstrating the actual application of the new methods. Also they can provide a means for helping to overcome problems that may develop.

Following are some examples of the progress achieved in marketing educational work:

(1) Quality Improvement

In Wisconsin two types of problems that frequently occur together and are troublesome in many areas are: (a) The quality of milk received for processing and (b) an understanding of the effect of dairy plant operation on the quality of milk and its products as well as processing efficiency. Producers have difficulty in obtaining better markets unless they have taken effective measures to correct unsatisfactory milk production and milk handling practices. Key employees of many plants do not have sufficient technical training for their dairy plant jobs. Substantial losses, apparent to the trained dairy technologists, may go unnoticed in many plants. The dairy industry in Wisconsin is of such magnitude that such a situation affects the general welfare. To help correct this situation an educational program is being directed at helping producers, plant operators and fieldmen understand and interpret the details of quality regulations as well as to assist them in making changes in physical facilities, methods and procedures so they will be more able to comply with market requirements. Technical assistance is given to plant operators to help them eliminate waste and operate their plants more efficiently.

(2) Improving the Flavor of Milk

Educational programs have helped bring about improved milk quality from the standpoint of bacterial count and sanitation. In many cases the flavor problem remains although the milk may be rated of high quality as far as bacteria and sediment are concerned. Research has

helped discover practices on farms, in processing plants, in distribution, and by consumers that affect milk flavor. At any of these stages of production or marketing the flavor may be affected adversely.

To bring about improved flavor in milk a program was launched in Vermont that involved practically every group and organization in the State that had an interest in the dairy industry. A local dairy publication referred to it as "The most intensive and well planned campaign ever staged in this section of the nation to increase consumer milk sales through the marketing of better tasting milk"

The objective of the program is to improve the flavor of milk by informing producers, milk handlers, retailers and consumers of practices that affect the flavor of milk as it moves from the cow to the consumer's table. A number of schools were held in the State to train teams to judge the flavor of milk. The teams judged the producer's milk as it was received at the plants. The results were sent on a score sheet to each producer along with Agr. Ext. Brieflet 956, "Good-Tasting Milk," which described methods of producing milk with good flavor and listed 8 different causes of some of the most common flavor defects.

During the winter of 1955-56, 98 percent of the 10,500 milk shippers in the State were scored three times. Early in the year one plant that had completed its third round of testing showed a significant increase in good tasting milk and a corresponding decrease in poor tasting milk.

It was feared that notifying producers of a low score for their milk would bring about repercussions. According to early observations dairymen had been most cooperative and welcomed suggestions from fieldmen. It was believed that a good understanding of the program had contributed to this part of the program where the role of human relations was quite important.

(3) Industry Adjustments

In Georgia production of manufacturing milk is increasing, although production is substantially below total utilization of milk in all forms in the State. Because the State produces only a small fraction of the manufactured dairy products consumed by the people, this offers an opportunity for considerable market expansion for local producers if they can meet the competition of manufactured dairy products produced in other areas.

An educational program has been developed to help bring about improvements in the dairy industry. One phase will be with processors, distributors, farmer organizations and others on those problems of an economic nature, including pricing, interpretation of statistics, outlook, and seasonal marketing problems. The other phase will deal

with problems of technology, and efforts will be directed toward proper plant layout, remodeling, efficiency in materials handling, criteria for work methods, short courses on training techniques for management and labor and related problems. One of the activities has been the establishment of a monthly newsletter to milk distributors. Among items of information furnished have been: The special milk program, Federal milk marketing orders, data on production, vending and dispensing, protective milk, bulk tanks, automation, sales data, dairy council, and a big push in connection with June Dairy Month.

(4) A Mass Media Approach

In Illinois dairy farmers and manufacturers of dairy products have expressed the need for greater emphasis on the preparation and distribution of educational information relating to the value of dairy products in human diets and the economics involved in the processing and distribution of milk and other dairy products.

In this project emphasis will be on the use of mass media to (a) encourage increased consumption of milk and dairy products by all consumers; (b) correct erroneous impressions regarding the place of milk in reducing diets; and (c) establish a better public understanding of pricing and other economic factors in milk marketing and distribution.

(5) The Multiplier Principle at Work

In Virginia the effort to bring about better understanding of industry problems where State milk control was in effect was also approached through a monthly "Market Review." It dealt with such topics as the calculation of blend prices, with particular emphasis on the fact that the Class I prices alone do not give an accurate picture of prices which producers actually receive; bulk tank premiums; quantity discount pricing; and continuing for a number of months was a discussion of topics taken from the Northeastern Milk Control Study published by Spencer and Christiansen. It is believed that this expanded the readership of that study manyfold.

(6) Increasing Emphasis on the Interpretation of Current Developments

An example of this work can be found in Wisconsin where a new butter grading program was initiated by action of the legislature in 1953 which makes mandatory the grade labeling of all butter sold at retail in the State. An educational program was conducted to give both operators of butter plants and graders the essential information and skills necessary to carry out the program intelligently. This involved general informational meetings with retailers and specific butter judging instruction for the industry graders who are licensed under the supervision of State employed graders. Also to make the program successful an informed public was essential, another contribution of the educational program.

(7) Consumer Information About Milk and Its Products

The consumer marketing program aims to furnish consumers with information to help them make rational choices among alternative food purchases. This is a consumer-oriented program; it is an urban centered program; it is an education program. Mass media are the major teaching tools.

In 10 years this program has grown from 11 States conducting work with 16 workers to 41 States, Puerto Rico, and Hawaii carrying on a program with 96 workers. Most all major cities of the country now are being serviced. The greatest growth has come about in the last two years. Expansion of consumer marketing programs in the South and West included work started in Atlanta, Ga.; Jackson, Miss.; Columbia, Mo.; Springfield, Mo.; St. Joseph, Mo.; and Hawaii. Programs have been approved for two additional cities in North Carolina and for a program in at least one city in Texas.

To illustrate how a State program operates and the subject matter involved, North Carolina serves as an example. Personnel located at North Carolina State College are responsible for gathering, interpreting, and disseminating food-marketing information. Their work is closely coordinated with the work of the researchers, resident teachers, and other extension personnel concerned with marketing. The information includes such things as current and future supplies and prices, new marketing practices, new products, relative cost, selection, care, value, and use of food and food products. In addition, information is provided to help consumers have a better understanding of the marketing system, functions, and problems. Information is disseminated directly to consumers in the Raleigh-Durham area through weekly TV programs, radio programs, and newspaper articles. The basic material is made available in a weekly release throughout the State to about 700 county Extension workers, to food editors, radio and TV personnel, nutritionists, and others interested in providing food-marketing information to consumers. The people receiving this release make any needed local adaptation before getting it out to consumers. During the year all the programs have gathered and disseminated marketing information on dairy products. While concern with dairy products is an ongoing matter not restricted to one time during the year, the staff in some areas worked on problems unique to their situation.

In Mahoning County, Ohio, an area where children drank little milk at school, work was initiated with community leaders to bring about a greater participation in the School Milk Program. As a result, the number of county schools taking part in the program jumped from 2 to 56.

In Wheeling, West Virginia, work was undertaken to encourage the use of cottage cheese during Lent, a season when cottage cheese was abundant locally and met the needs of a temporary change in meat consumption. The approach to encourage consumption of cottage cheese was many-sided--

through TV and radio programs, special news releases, and through the distribution of 150,000 copies of a consumer leaflet. At the close of the campaign, 6 leading dairy plants in the State reported an increase in cottage cheese sales of 23 per cent over the same period a year earlier.

Plans

Increased efforts will be directed to work with utilization research workers on new dairy product developments. Major emphasis will go to evaluating and strengthening the present consumer marketing programs. The needs for the programs within each State will determine the plans for expansion.

PROPOSALS
for
COMMITTEE CONSIDERATION

1. Increased Emphasis on Helping People Analyze the Problems of the Dairy Industry so as to Bring About An Understanding to Help Them Take Action that Would Lead to an Improved Situation
 - (a) Consider the role of price as a guide to production and consumption and the establishment of prices of milk under modern conditions of marketing.
 - (b) Explore the principles of marketing with groups of young people who will become dairy leaders of tomorrow.
 - (c) Examine the concept of parity (and parity equivalent) and the price relationship between various manufactured dairy products.
 - (d) Analyze the nature and degree of competition among milk producers for a limited market, both locally and nationally.
 - (e) Examine the factors in the marketing of milk that at times lead to civil strife but which are not present in the marketing of most other agricultural commodities.
2. Increased Emphasis on the Interpretation of Current Developments so That an Understanding of the Reasons Behind These Happenings Can Help Those Affected in Making Decision in Adjusting to the New Situations
 - (a) Application of outlook information.
 - (b) The economics of dispensers, vending machines, bulk farm tanks, multiple containers, and similar technological developments.

(c) Consideration of governmental actions, local, State, and Federal that bring about situations that affect marketing procedures and cause considerable concern particularly among producers, for example, a requirement that after a given date producers cannot market milk in a certain area or market unless it is from brucellosis free cows; changes in or discontinuance of State milk control; or a change in the price support level.

3. Increased Emphasis on the Application of Technology

(a) The short-time process for making cheddar cheese.

(b) Recent development in waste disposal.

(c) Problems associated with assembly and receiving of milk, sanitation, weighing and testing, plant arrangement, efficiency of operation, and such factors.

(d) Recent research on improving the handling, quality maintenance, and merchandising of milk and dairy products in retail food stores.

4. Further Expansion of Consumer Information About Milk and Its Products

(a) Different forms of milk and kinds of dairy products, as well as suggestions for handling and using.

(b) Relative food costs and using milk in the diet--including reducing diets.

C. STATE DEPARTMENTS OF AGRICULTURE

1. Service Work

AMS-SDA

During the past year 20 State Departments of Agriculture carried on marketing service activities pertaining to dairy products. The work centered around (1) improving and maintaining product quality and expanding market outlets, (2) technical assistance in improving marketing facilities and equipment, and (3) the collection and dissemination of local and nearby market information and other basic data.

(a) Improving and Maintaining Product Quality and Expanding Market Outlets

Marketing services bearing on improvement and maintenance of dairy product quality were provided by State Depts. of Agr. in Alaska, Colorado, Indiana, Kansas, Louisiana, Minnesota, Mississippi, Missouri, Montana, North Dakota, Wisconsin, Wyoming, and Vermont. Demonstrations and assistance were given to producers, plant managers and other plant employees, dealers, and retailers in the determination of causes of poor quality and in proper methods of handling dairy products to,

within and from the plant, in storage and at the retail store to insure quality maintenance throughout the distribution system. In addition, proper methods of grading and classifying milk, cream, butter and cheese according to established standards were demonstrated to plant employees. Special programs to improve and widen the distribution of dairy products were conducted in Illinois, Indiana, Louisiana, Maine, Minnesota, North Carolina, Washington, and Wisconsin.

In cooperation with the Denver Milk Producers Association and the Dairy Dept. of Colo. A & M College, the Colo. Dept. of Agr. continued its program of assistance to producers and milk plants in improving the quality of milk and milk products. Two flavor surveys on milk and ice cream revealed a serious off-flavor and off-odor condition of milk produced on a number of farms in the Denver milkshed and milk plant practices which tended to perpetuate the quality problem. To bring about corrective measures on dairy farms, specialists continued the program of assistance to individual producers in identifying quality problems and in effecting solutions to the problems. Fieldmen from the dairy plants were trained in quality improvement procedures so that the benefits of the program could be expanded and placed on a continuing basis. Work was conducted with 18 of the milk plants serving Denver on problems of quality control in their plants. One phase of this work was to train men at the milk receiving platforms in quality determination to prevent milk of unacceptable quality from entering the plants. These plants had been following the practice of accepting poor-quality milk, which they diverted into milk products. Since the establishment of quality control at the receiving platform would give rise immediately to the problem of rejected milk, assistance was given the Health Department in developing regulations to control the transfer of rejected milk to other plants in the area. Two of the plants are in the process of developing a plan to include flavor as one of the price-determining factors for milk received from producers. If successful, this plan probably would spread to other plants and would provide an incentive for production of quality milk. Progress in conducting this program to date has revealed a number of problem areas and an urgent need for programs to: (a) Bring about mastitis control in Colorado, (b) develop a uniform flavor-improvement procedure, and (c) improve some industry practices which now tend to discourage quality improvement.

The Minnesota mobile bacteriological laboratory was utilized again last year in the program of aiding manufacturing plants to locate and correct conditions causing quality deterioration in milk and dairy products. Samples are drawn of incoming raw milk and of various manufactured dairy products at several points in the processing line and submitted to the mobile laboratory for analysis. The results of the analysis are reported back to the plants for any necessary corrective action. The improved quality of dairy products brought about by this program and other efforts has made it possible for Minnesota dairy plants to compete more effectively for out-of-State markets--an important

consideration since 80 percent of the total volume of dairy products moves to other States as fluid milk, butter, cheese and dry milk powder. The program of encouraging the installation of milk vending machines in manufacturing plants, large offices and bus and railroad terminals in the Twin City area and Duluth was continued. Under the stimulus of the program vending machine companies have established about 600 machines in the Twin Cities and nearly 100 machines in Duluth. Assistance was provided in extending the School Milk Program to schools in the small towns of the State by arranging meetings between school officials and dairy plant operators.

Missouri is surveying the dairy plants in the State with respect to quality problems. The results of this survey are to form the basis for development of a quality improvement program.

In Mississippi, considerable reduction has been achieved in the quantity of milk rejected by dairy plants through a quality-main-tenance program at the product level (coop. Ext. Service). Nearly 600 producers delivering milk of poor quality to 4 fluid milk and 4 manufacturing plants were visited and given advice and assistance in the proper handling of milk and in installing the equipment required to maintain quality.

Montana continued to assist processors, wholesalers, and retailers in improving the methods of handling and in maintaining the quality of dairy products. Several times during the year scorings were made of butter, ice cream, and cottage cheese samples from each manufacturing plant. District meetings were held with plant personnel to discuss these scorings and the improvements that processors might make in plant operations and equipment to maintain quality more effectively. In addition, a large number of retail stores were visited to appraise the adequacy of the refrigeration facilities available for storing and displaying dairy products and to suggest improvements in handling methods to store managers.

Very intensive quality improvement services are being provided by Wisconsin in certain counties. During the period the program has operated in Sheboygan County, the proportion of milk delivered to dairy plants falling into the top grade, according to the sediment test, increased from 19 percent in 1951 to 34 percent in 1955. The program to improve the quality of butter has had significant results. In 1951, when an expanded program (coop. Uni. Wis.) for butter quality improvement was initiated about 41 percent of the butter produced in the State graded Wisconsin A and AA. By 1955, this percentage had increased to nearly 59 percent. Over this same span, the percentage of Wisconsin undergrade (scoring 89 or less) dropped from 37 percent to 7 percent. Also continued was the aggressive market expansion program for dairy products. For cheese, major emphasis was placed on "Cheese Week" campaigns in out-of-State markets. This past year such campaigns were conducted in 21 cities as compared to 10 cities during

the preceding year. In these campaigns, Wisconsin assists wholesalers and retailers in planning and conducting publicity programs through the various media, trains demonstrators for in-store promotion, and conducts demonstrations of the kinds and uses of cheese in meal planning before high school and college cooking classes, food editors, and television audiences. Wisconsin also staged cheese exhibits at a number of fairs and conventions outside the State. Intensive promotional activities, including June Dairy Month and the October Cheese Festival, were carried out within the State in cooperation with the Amer. Dairy Assn. of Wis. A survey of 21 retail food chains and independent wholesale grocers revealed an average increase of 16 percent in cheese sales during October 1955 over October 1954.

Purdue University continued its program designed to promote correct grading of milk and cream purchased by plants, advance the use of uniform grades and standards by dairy plants, and generally improve the quality of dairy products produced in Indiana. Cooperating in this project are 71 milk plants and 28 butter plants which handle approximately 65 percent of the milk and 85 percent of the churn cream sold at wholesale from Indiana farms. A total of 310 surveys of milk grading procedures and 396 on cream grading were made in the field during the year. A series of 8 milk graders' and 11 cream graders' schools were held over the State. At these schools nearly 700 approved graders, fieldmen, haulers and milk sanitarians received instruction on milk and cream grades, grading methods and everyday problems with which graders are commonly confronted.

Vermont (coop. Vermont Dairy Industry Commission) instituted a marketing service program to assist producers and milk plants in overcoming milk quality problems resulting from the presence of off-flavors and off-odors. Although this program has been in effect for less than a year, the flavor problems have been discussed with plant personnel at all but 4 of Vermont's 83 plants shipping to out-of-State markets. Assistance has been given plant technicians in testing for flavor and fieldmen in proper follow-up procedures to detect and correct conditions on dairy farms responsible for off-flavors and off-odors. Producers samples of milk retailed in Vermont were collected regularly by State inspectors, tested for flavor and in cases where the tests reveal a flavor problem a report made to the distributor handling the particular producer's milk. A follow-up to determine what action the distributor takes with respect to the problem is made.

(b) Technical Assistance in Improving Marketing Facilities and Equipment

Technical assistance in improving marketing facilities and equipment was provided by the State Depts. of Agr. in Colorado, Indiana, Kansas, Louisiana, Minnesota, Mississippi, Montana, North Dakota, Wisconsin, and Wyoming. Further expansion of these activities is planned in a number of these States and in other States in the matched fund program.

At Purdue University, an interdepartmental committee was established to develop and make recommendations concerning the installation and use of farm bulk milk tanks. This committee, which includes representatives from the Indiana State Board of Health, issued during the year a 20-page publication on this subject. There are about 1,400 bulk tank installations in Indiana and as a result of this change in milk marketing new problems in milk grading and handling have developed.

In Louisiana, continued assistance to dairy plants in improving plant efficiency and in reducing the cost of making deliveries is provided.

The number of dairy plants in Wisconsin continued to decline as many smaller plants are liquidated and consolidations take place. Technical assistance has been provided in the reorganization, location, and financing of new multiple purpose plants to replace the smaller inefficient units. The Departments of Agriculture in Montana and Minnesota have provided a somewhat similar service to dairy plants in those States.

(c) Collection and Dissemination of Local and Nearby Market Information and Other Basic Data

Producers, handlers, and processors have requested data on basic production and consumption trends and on current marketing developments in order to plan effective marketing programs. Important types of information required are trends and current data with respect to dairy cattle numbers, milk production, storage holdings, changes in consumer demand, the competitive situation in market, and prices. Basic data and information relating to these items were collected, analyzed, and reported to producers and marketing agencies in Alaska, Iowa, Indiana, Louisiana, Minnesota, New Jersey, New York, South Dakota, West Virginia, and Wisconsin.

Iowa continued background work in integrating available information relating to milk production and marketing patterns in the State. Data on feed fed dairy animals, utilization and prices for dairy products are being readied for inclusion in a forthcoming publication.

West Virginia inaugurated a monthly dairy news report carrying such items of interest to dairymen and dairy plants as monthly milk production, prices received for milk, and prices paid for dairy feeds. This report is disseminated to a mailing list of about 1,500 producers and plants and is reproduced in part in most newspapers of the State.

Wisconsin has been issuing a report of this nature for several years. The Wisconsin publication, however, reports milk prices on both an actual and 3.5 percent butterfat basis to enable producers and handlers to readily compare returns for milk sold for various uses.

The New Jersey Crop Reporting Service issued a special dairy release providing (1) monthly data on milk production; (2) estimates of milk cow numbers, average production per cow, and total milk production by counties in 1954; (3) trends in milk prices at wholesale and retail; and (4) cash receipts from dairy products.

PROPOSALS
for
COMMITTEE CONSIDERATION

Expand service work conducted by State Department of Agriculture, or other appropriate State agency, with emphasis on programs to:

- (a) Improve and maintain the quality of dairy products through development and adoption of better handling methods at all levels of distribution and the adoption of proper methods of grading and classifying milk, butter, cream, and cheese according to established standards.
- (b) Improve existing facilities and the design and location of new facilities, such as country processing plants, and advise marketing agencies with respect to the kinds of handling equipment and methods best suited to their operations.
- (c) Widen market outlets and move seasonal surpluses by providing producers and marketing agencies with complete information on the location of surplus and deficit areas; and by providing promotional assistance.



